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WADC TECHNICAL REPORT 56-645
PART IV

PROPERTIES OF GLASSES AT ELEVATED TEMPERATURES

Matthew J. Kerper
C. C. Diller
E. H. Eimer

National Bureau of Standards

MAY 1960

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WRIGHT AIR DEVELOPMENT DIVISION

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NATIONAL BUREAU OF STANDARDS, Washington, D. C., PROPERTIES OF GLASSES AT ELEVATED TEMPERATURES, by Matthew J. Kerper, C. C. Diller and E. H. Eimer, February 1960. 64p. incl. figs. tables, 4 refs. (Proj 7340; Task 73400) (WADC TR 56-645, Pt IV) (Contract AF 33(616)-56-13)

Unclassified report

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MAY 1960

Materials Central
Order No. AF 33(616) 56-13
Project No. 7340

WRIGHT AIR DEVELOPMENT DIVISION
AIR RESEARCH AND DEVELOPMENT COMMAND
UNITED STATES AIR FORCE
WRIGHT-PATTERSON AIR FORCE BASE, OHIO

300 – September 1960 – 1-37

FOREWORD

This report was prepared by the National Bureau of Standards under Air Force Order No. AF 33(616)-56-13. The contract was initiated under "Project No. 7340 - Non-Metallic and Composite Materials", Task No. 73400 - "Organic and Inorganic Plastics." The work was under the direction of the Materials Laboratory, Directorate of Laboratories, Wright Air Development Division, with Mr. R. E. Wittman as project officer.

This report covers work conducted from January 1959 to December 1959.

The mechanical testing was performed in the Glass Section under Mr. C. H. Hahner, the Section Chief. The statistical analysis was made by J. M. Cameron of the Statistical Engineering Section.

ABSTRACT

In order to establish realistic design information applicable to several special glasses, data have been obtained on the stress-rupture characteristics and the elongation during the stress-rupture tests at room temperature, 700°F, and a temperature 50°C below the strain point for Corning Glasses 1723 and 7740, and Pittsburgh Plate Glass 3325. Data are also presented on the effect of the rate of loading on strength.

PUBLICATION REVIEW

This report has been reviewed and is approved.

FOR THE COMMANDER:

W. E. DIRKES
Chief, Plastics Branch
Nonmetallic Materials Laboratory
Materials Central

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INTRODUCTION

The high speeds of modern aircraft and the resulting high operating temperatures they face presents the problem of finding a material for aircraft enclosures that will withstand high temperatures as well as stresses introduced by thermal gradients and loading. For the proper utilization of glass in these applications, accurate information on its properties at elevated temperature is required.

This program was initiated by the Wright Air Development Center with the objectives of: 1) developing test methods for measuring the effect of temperature on the physical properties of glass, and 2) determining the properties of some presently available commercial glasses that appear to be suitable for aircraft glazing. The properties determined were stress-rupture and creep during stress-rupture. Corning Glass Works (CGW) 1723 and Pittsburgh Plate Glass (PPG) 3235 were tested in the annealed, semi-tempered and tempered conditions while Corning Glass Works (CGW) 7740 was tested in the annealed and semi-tempered conditions.

This report is the fourth annual summary report and covers the work completed between 1 January 1959 and 31 December 1959.

Manuscript released by authors, February 1960 for publication as a WADC Technical Report.

SPECIMENS

The glasses that were tested are listed in Table I along with their coefficients of expansion and strain points.

Table I. Glasses Tested

Glass	Coefficient of Expansion 10^{-7} per °C	Strain Point[1/] °C	°F
PPG 3235 (Borosilicate)	62.0	493	920
CGW 1723 (Aluminosilicate)	42.0	672	1242
CGW 7740 (Borosilicate)	32.0	515	959

Specimens were 10 inch by one-and-a-half inch strips cut from plate glass approximately one-quarter inch thick. Specimens were from the same lots that were used for the other testing (1). The CGW 1723 specimens were tested in the annealed, semi-tempered, and tempered condition as were the PPG 3235 specimens. The CGW 7740 specimens were tested in the annealed and semi-tempered conditions. All specimens were sandblasted. The sandblasting was applied to a circular area one and one-quarter inches in diameter in the center of the side of the specimen opposite the scored surface. The specimens were loaded so the sandblasted side was tested in tension. Details of specimen preparation have been previously reported (1).

1/ The strain point is defined by ASTM (C 162-56) as: "The temperature at which the internal stress is substantially relieved in four hours. The strain point corresponds generally to the lower end of the annealing range. The strain point corresponds to a viscosity of $10^{14.50}$ poises when measured by the Method of Test for Annealing Point and Strain Point of Glass (ASTM Designation: C336).

APPARATUS AND PROCEDURE

The stress-rupture and creep specimens were tested in flexure on the stress-rupture apparatus; they are supported on knife edges eight inches apart and are loaded through two knife edges two inches apart. Hanging dead weights supply the load. Sixteen stress-rupture assemblies are mounted in individual furnaces and eight are mounted in a constant temperature-humidity chamber. A differential transformer mounted above each specimen measures the amount of deflection and creep; plotting deflection against time on a strip chart. A detailed description of the stress-rupture testing apparatus has previously been reported (2).

Three test temperatures were used: 75°F (and 50% relative humidity), 700°F, and a temperature 50°C (122°F) below the strain point of the glass. Three stress levels were used at each temperature, and these were a percentage of the average modulus of rupture determined at the testing temperature. Ten specimens were tested at each condition of temperature and stress.

Specimens were stressed for 500 hours, or until creep became excessive for the apparatus or the specimen broke.

RESULTS & DISCUSSION

Stress-Rupture and Creep

The results of the stress rupture tests made at 75°F on the three glasses are presented as a graph. The results of the elevated temperature tests are not plotted because of the few failures that occurred in the 500 hour test period. The results for each specimen tested in stress-rupture are presented in Appendix I.

The results of the creep tests are presented as curves; two figures are presented for each condition of temper for each glass. The two figures picture the same data: the first, plotted on an arithmetic time scale, shows the results of first three hours of test and the second, plotted on logarithmic time scale, shows the entire creep curve. Creep curves that do not extend the entire 500 hour period indicate that creep became excessive for the test apparatus and the test was halted. The curves were obtained by plotting the average deflection of the ten test specimens or when failures occurred the average deflections of the specimens that survived at the testing temperature.

Stress-Rupture and Creep of PPG 3235

The results of the stress-rupture tests made at 75°F on PPG 3235 specimens are presented in Figure 1. The results show that at 75°F some failures of annealed specimens occurred at 45% stress. At 700°F two specimens broke at 60% stress. At 830°F, one specimen broke at 60% stress and one specimen broke at 75% stress.

The results for the semi-tempered specimens showed no failures at 70% stress but failures occurred at 80% and 90% stress. The stress-rupture tests at elevated temperatures showed no failures at 700°F and only one at 830°F, occurring at 70% stress.

The tempered specimens tested at 75°F showed no failures in the stress-rupture tests at 70% and 80% stress but did show some failures at 90% stress. At 700°F there were three failures at 90% stress and none at 70% and 80% stress. At 830°F there was one failure at each of the three stress levels. Detailed results of the stress-rupture testing are presented in Appendix I.

Creep was observed at both 700°F and 830°F at all three stress levels and for all three conditions of temper. The creep curves are presented in the following figures: annealed, 2 and 3; semi-tempered, 4 and 5; tempered, 6 and 7.

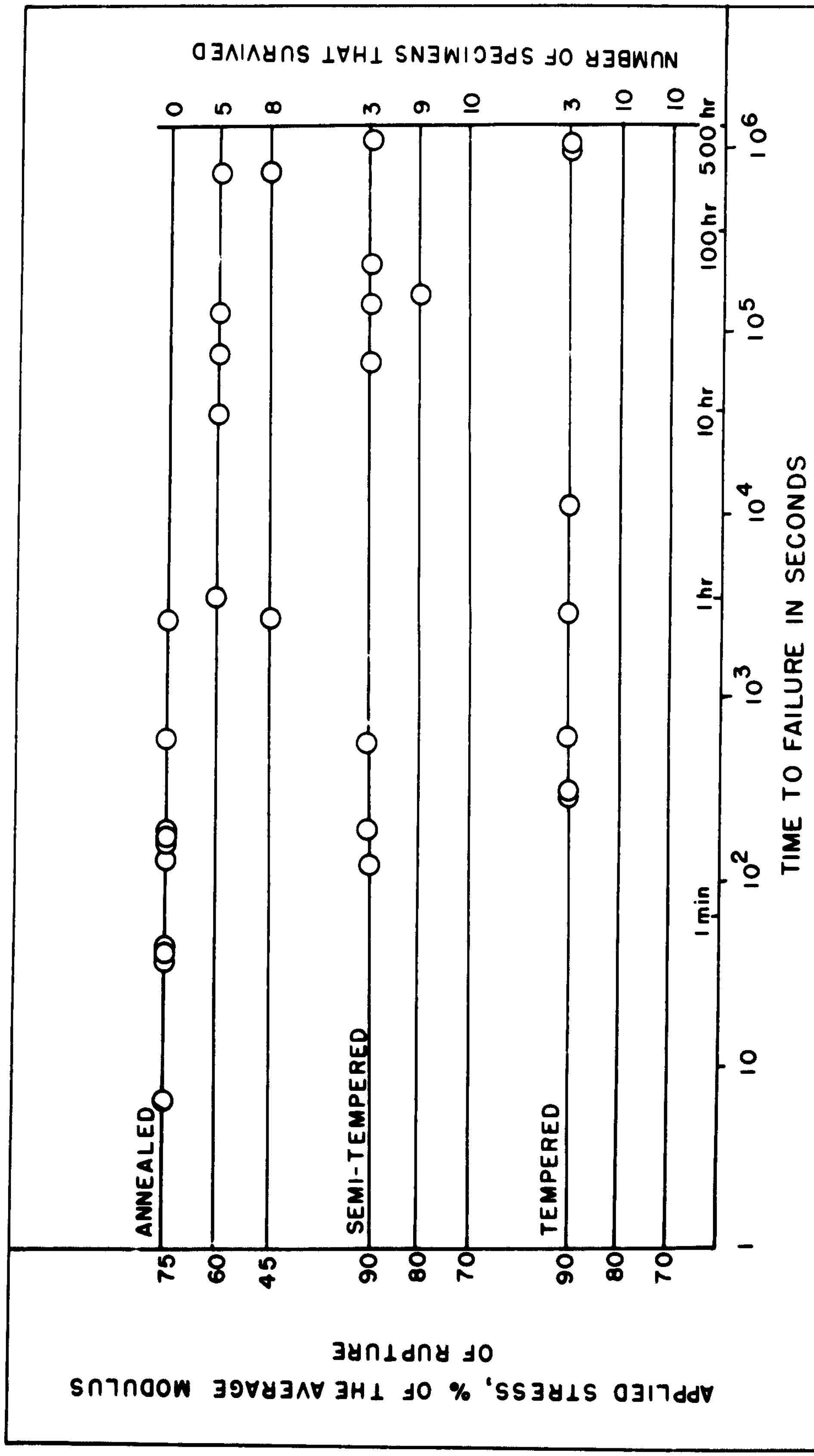

FIGURE 1. TIME TO FAILURE FOR PPG 3235 SPECIMENS UNDER SUSTAINED LOAD AT 75°F

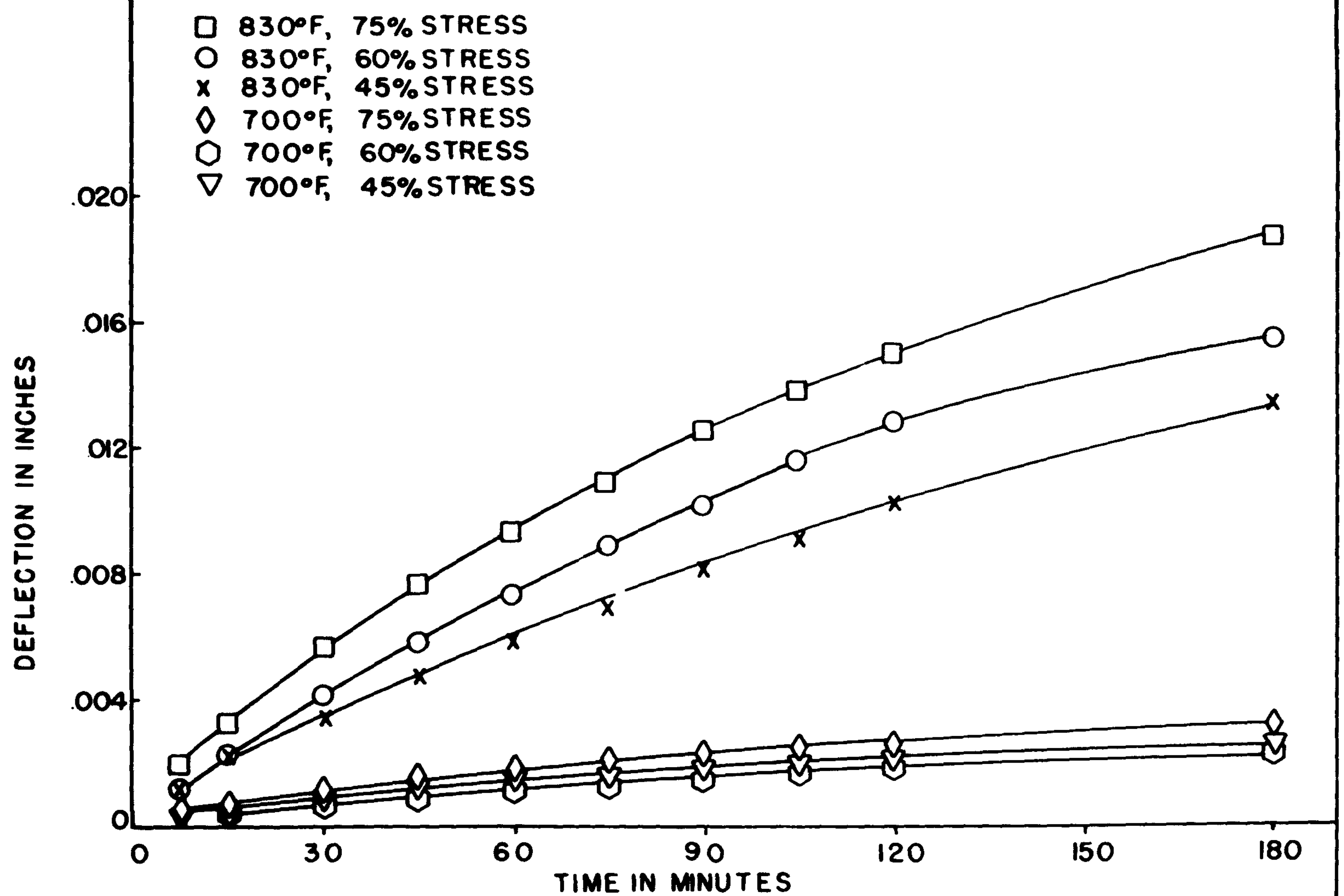

FIGURE 2. DEFLECTION-TIME CURVES FOR ANNEALED, SANDBLASTED, PPG 3235 SPECIMENS UNDER SUSTAINED LOAD

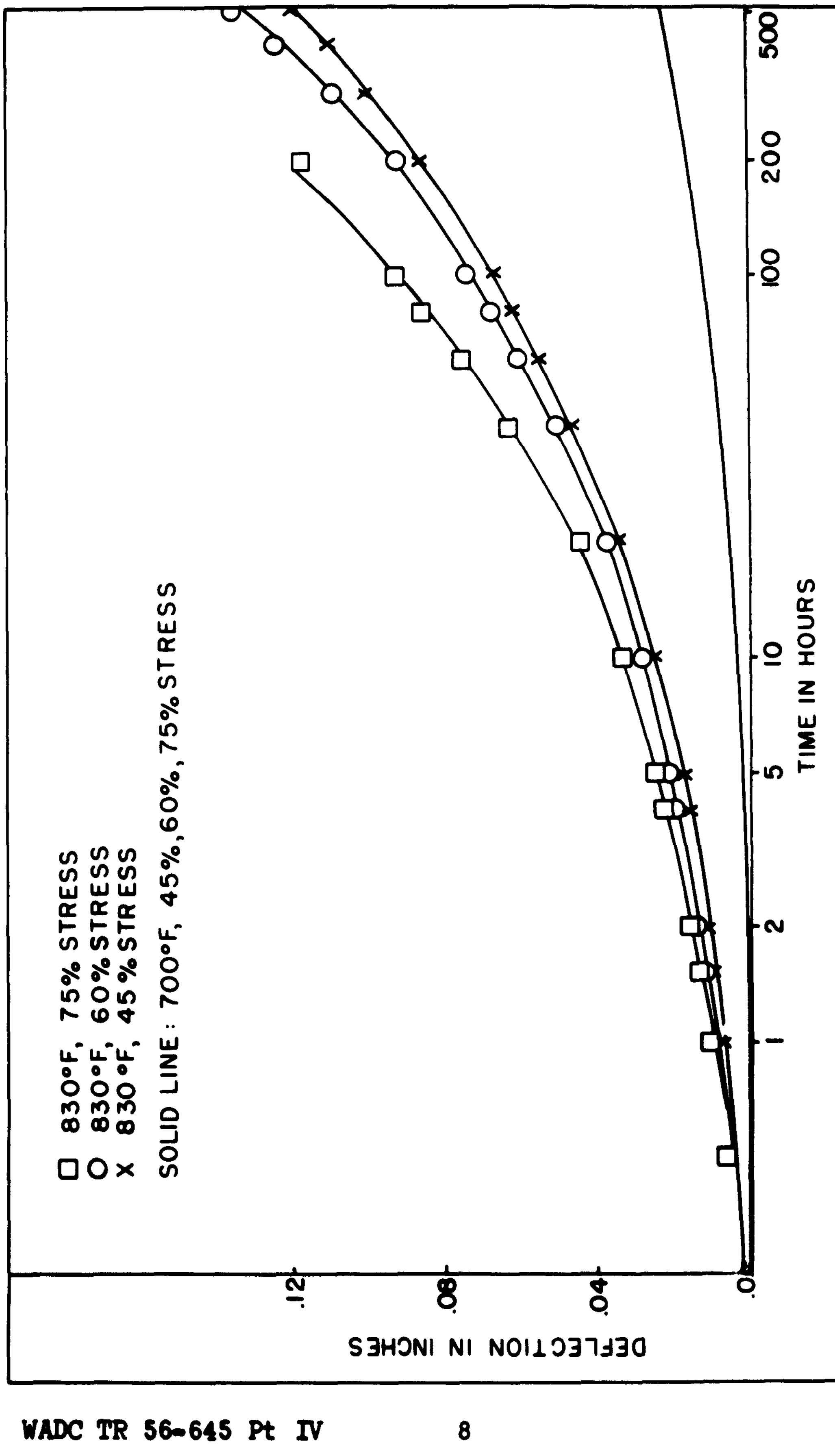

FIGURE 3. DEFLECTION-TIME CURVES FOR ANNEALED, SANDBLASTED, PPG 3235 SPECIMENS UNDER SUSTAINED LOAD.

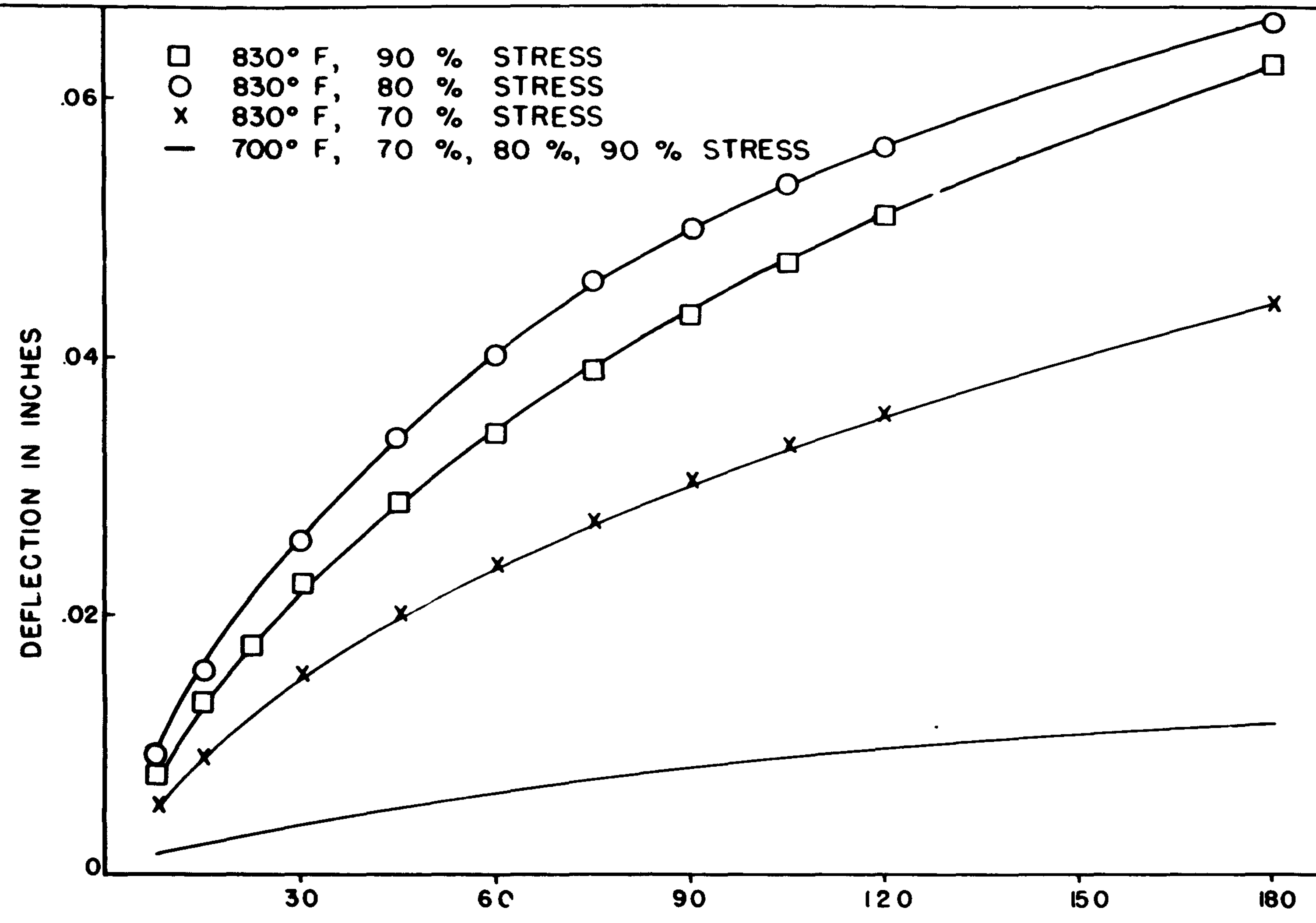

FIGURE 4. DEFLECTION-TIME CURVES FOR SEMI-TEMPERED, SANDBLASTED, PPG 3235 SPECIMENS UNDER SUSTAINED LOAD

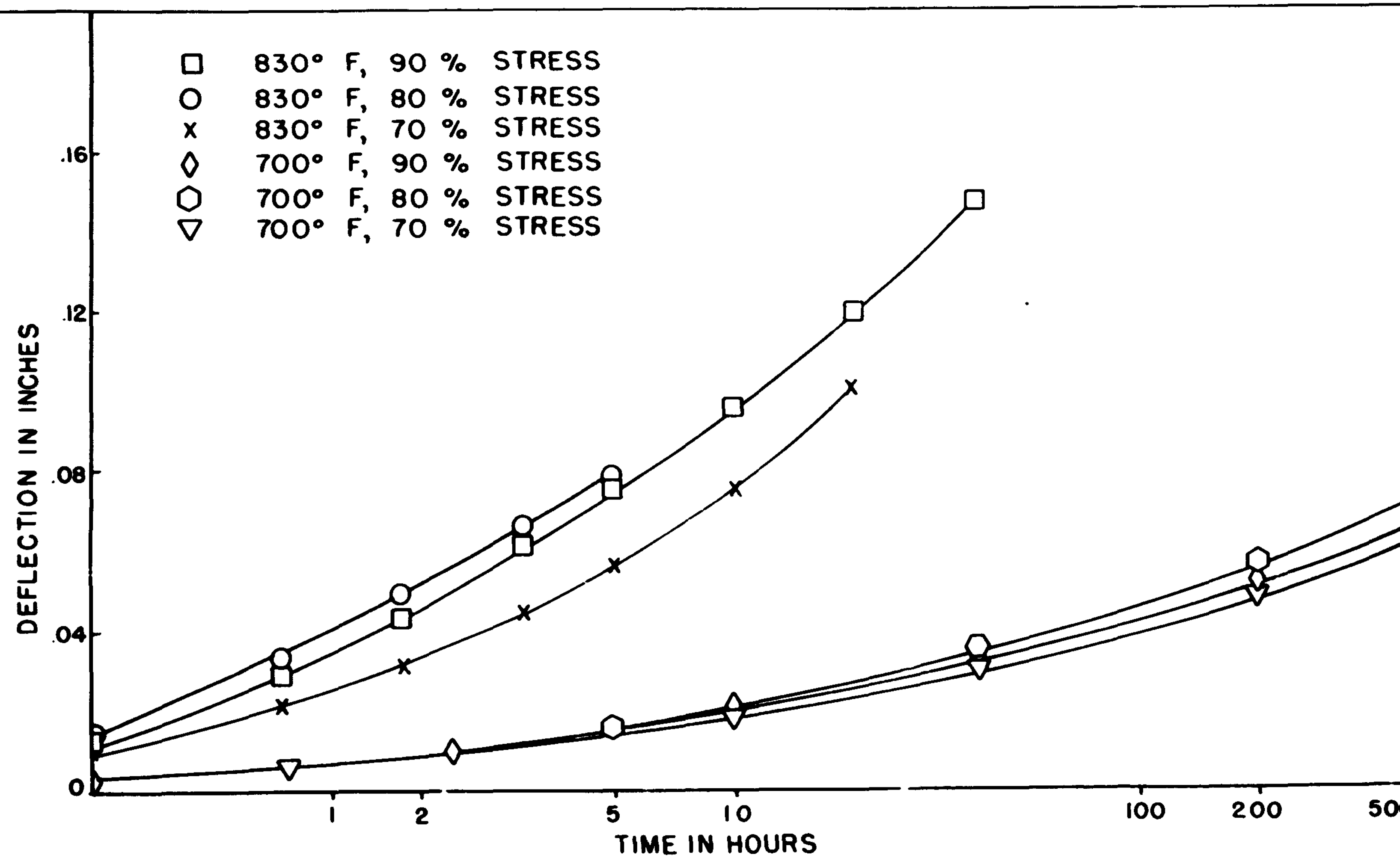

FIGURE 5. DEFLECTION-TIME CURVES FOR SEMI-TEMPERED, SANDBLASTED, PPG 3235 SPECIMENS UNDER SUSTAINED LOAD

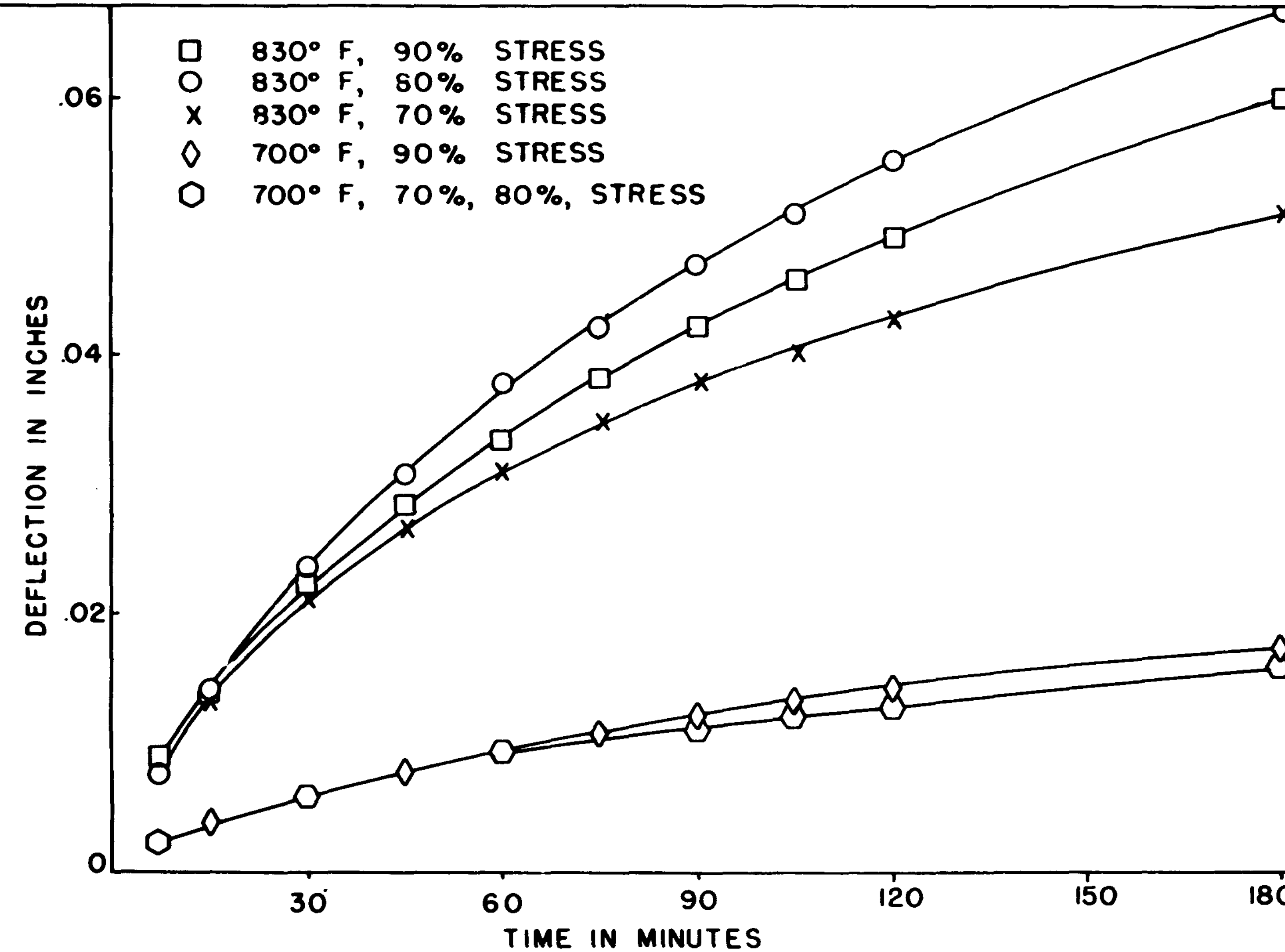

FIGURE 6. DEFLECTION-TIME CURVES FOR TEMPERED, SANDBLASTED, PPG 3235 SPECIMENS UNDER SUSTAINED LOAD.

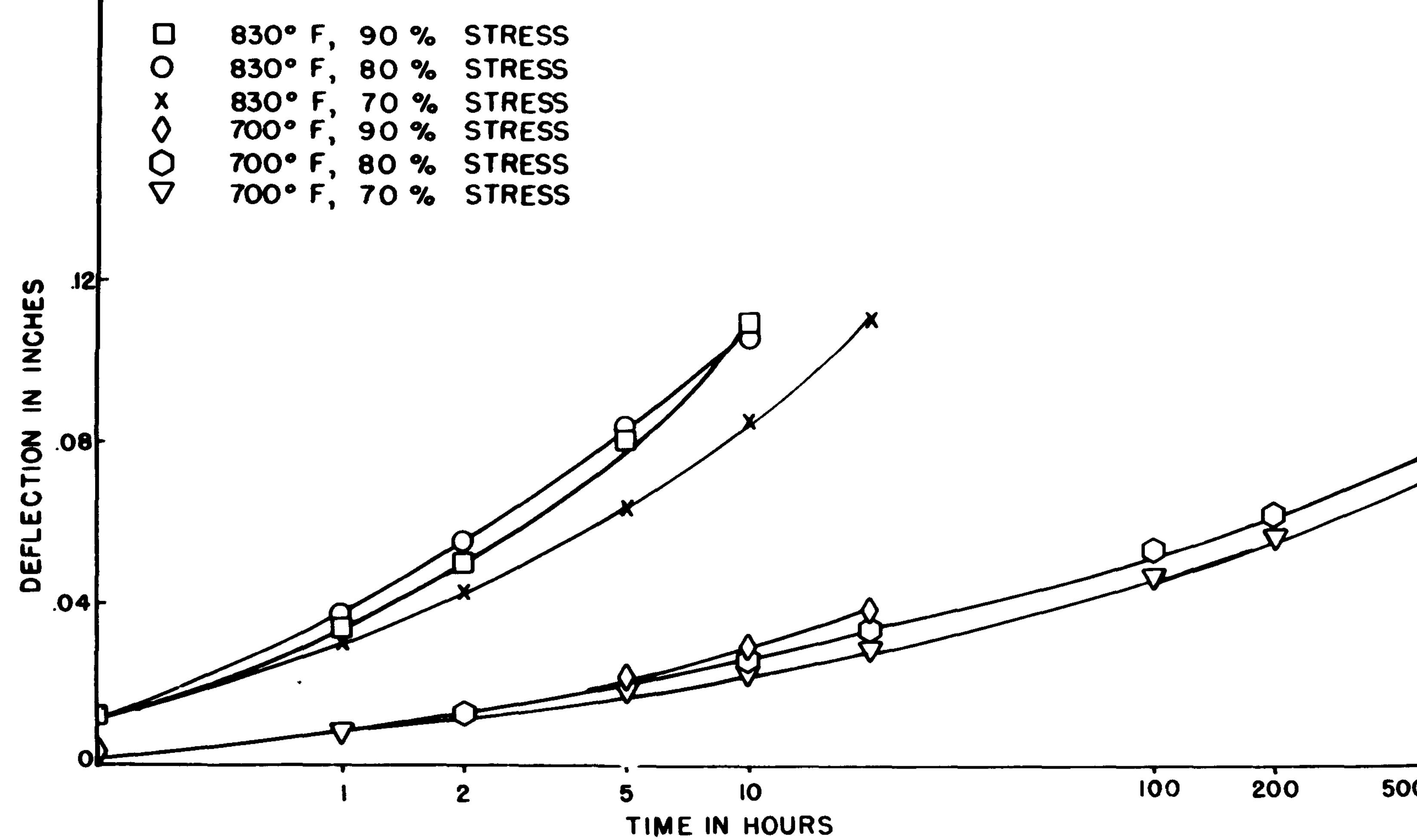

FIGURE 7. DEFLECTION-TIME CURVES FOR TEMPERED, SANDBLASTED, PPG 3235 SPECIMENS UNDER SUSTAINED LOAD.

Stress-Rupture and Creep of CGW 1723

The results of stress-rupture tests made at 75°F on CGW 1723 specimens are presented in Figure 8. The results show that annealed specimens broke at the 45% stress at 75°F. At 700°F, only one specimen failed and that was at 75% stress. At 1150°F one specimen failed at 60% and three at 75% stress.

With semi-tempered specimens tested at 75°F there was only one failure at 60% stress level but there were more failures at the 75% and 90% levels. At 700°F, only one specimen failed and that was at 90% stress. At 1150°F, two specimens failed, both at 90% stress.

The tempered specimens tested at 75°F showed no failures at 60% and 75% stress levels but showed failure at the 90% level. There were no failures at 700°F and only two at 1150°F, both at 90% stress. Detailed results of the stress-rupture testing are presented in Appendix I.

No creep was noted at 700°F for the annealed specimens, but creep was noted for all three stress levels at 1150°F. The creep curves for the annealed specimens are presented in Figures 9 and 10.

A small amount of creep was noted for the semi-tempered specimens at 700°F, the amount being approximately the same for all three stress levels. At 1150°F creep was appreciable for all three stress levels. The creep curves obtained for the semi-tempered specimens are presented in Figures 11 and 12.

A small amount of creep was noted at 700°F for the tempered specimens with the amount of creep being appreciable for all three stress levels at 1150°F. The creep curves obtained for the tempered specimens are presented in Figures 13 and 14.

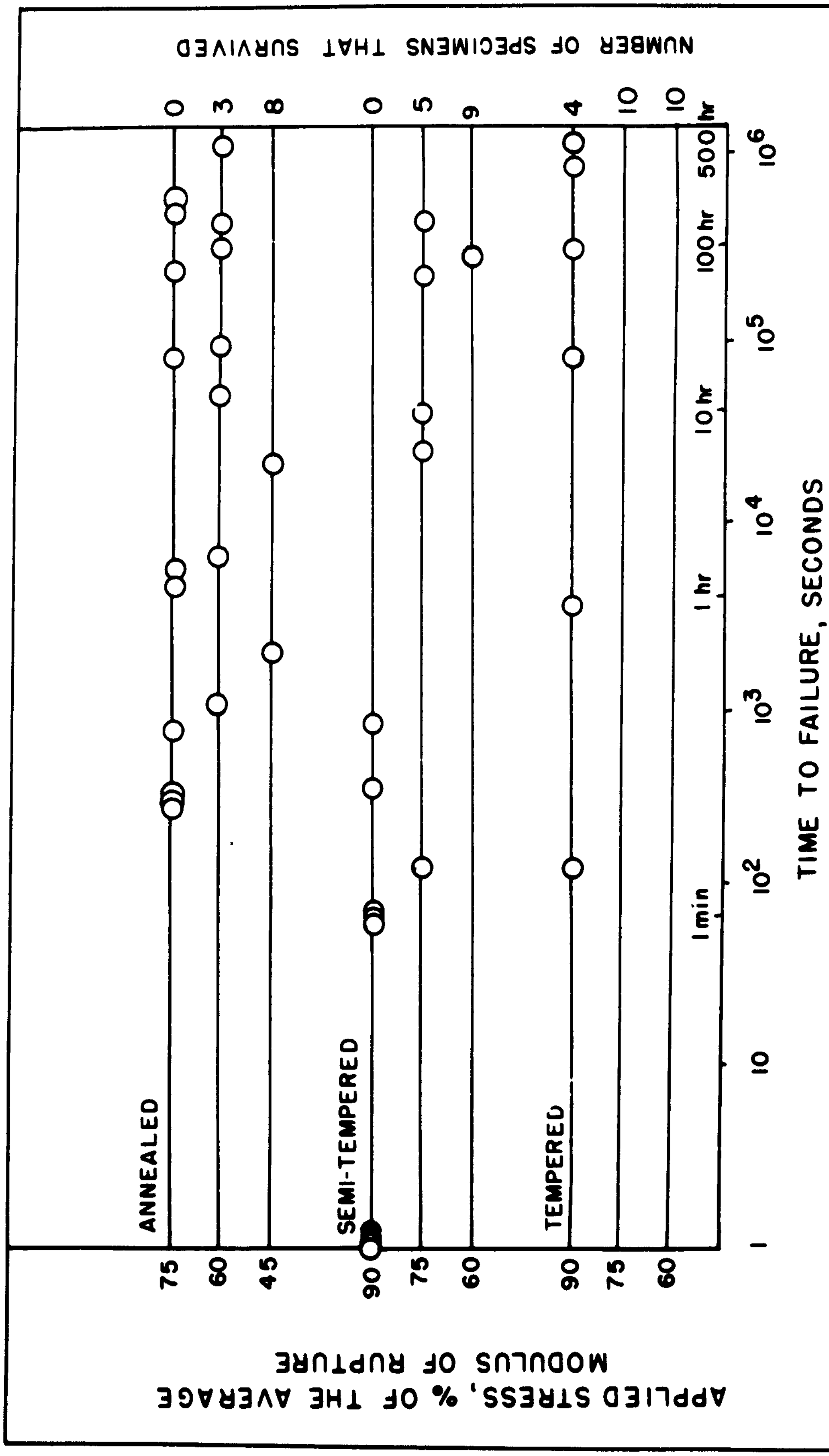

FIGURE 8. TIME TO FAILURE FOR CGW 1723 SPECIMENS UNDER SUSTAINED LOAD AT 75°F

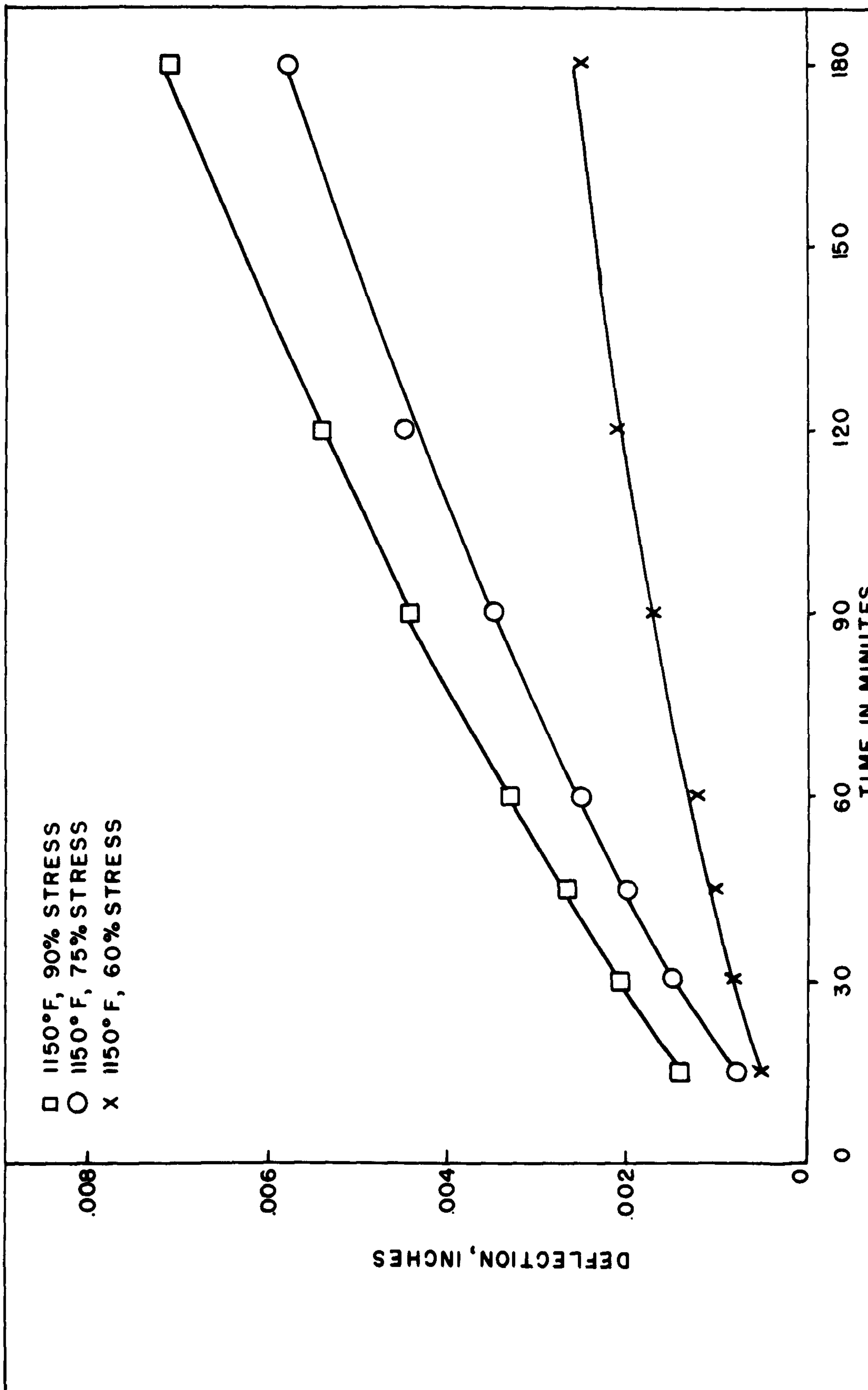

FIGURE 9. DEFLECTION-TIME CURVES FOR ANNEALED, SANDBLASTED, CGW 1723 SPECIMENS UNDER SUSTAINED LOAD

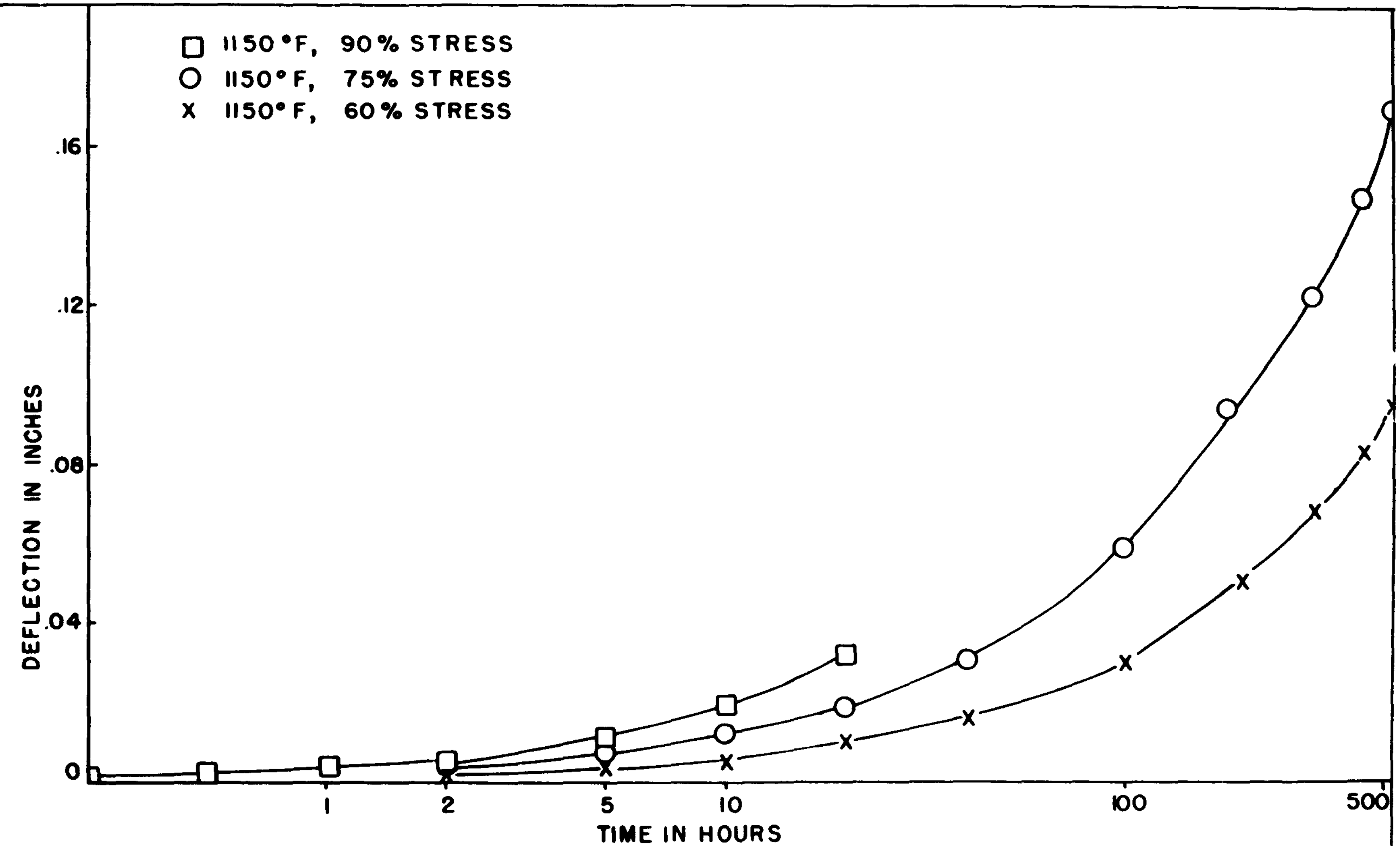

FIGURE 10. DEFLECTION-TIME CURVES FOR ANNEALED, SANDBLASTED, CGW 1723 SPECIMENS UNDER SUSTAINED LOAD

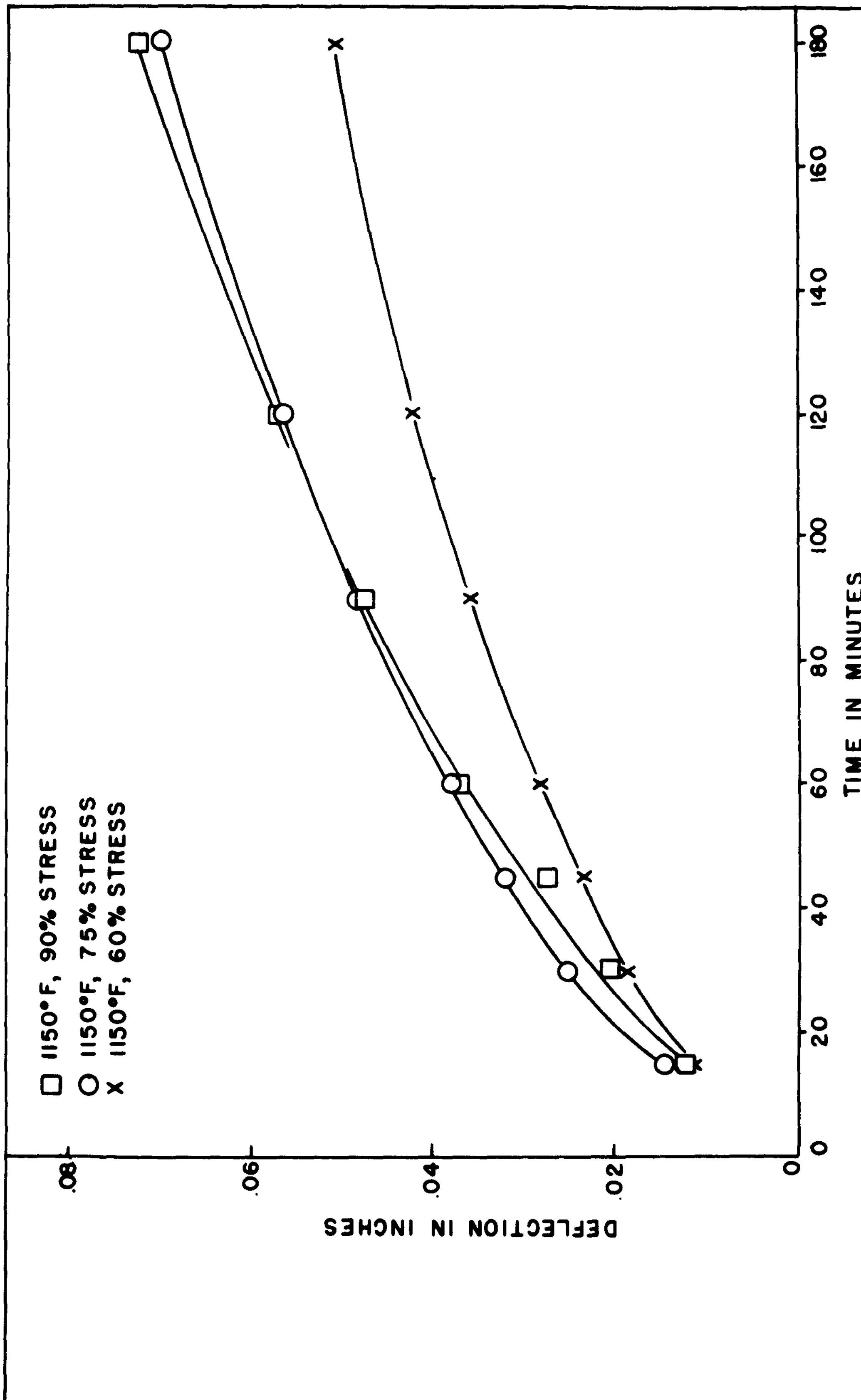

FIGURE 11. DEFLECTION-TIME CURVES FOR SEMI-TEMPERED, SANDBLASTED, CGW 1723 SPECIMENS UNDER SUSTAINED LOAD

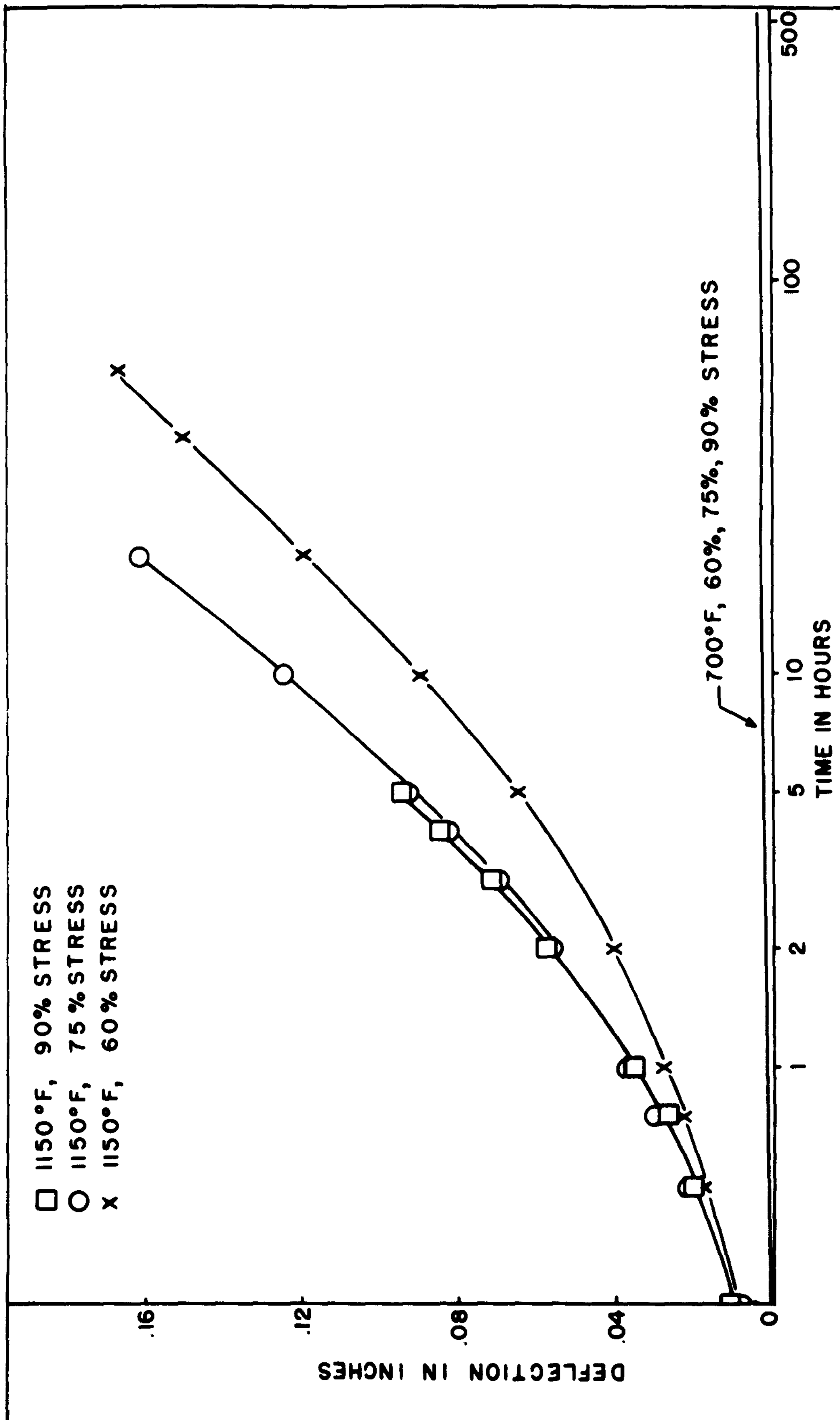

FIGURE 12. DEFLECTION-TIME CURVES FOR SEMI-TEMPERED, SANDBLASTED, CGW 1723 SPECIMENS UNDER SUSTAINED LOAD

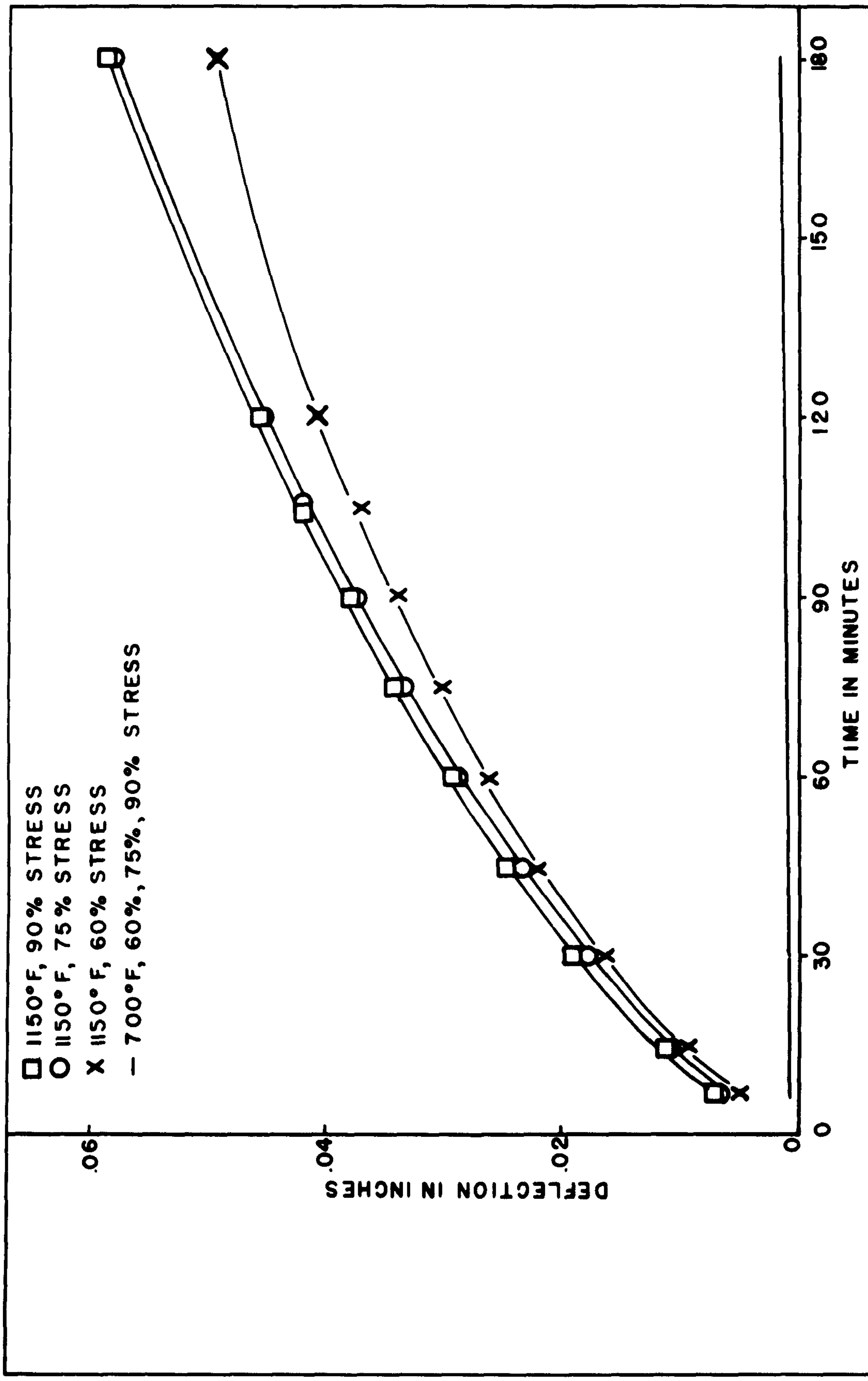

FIGURE 13. DEFLECTION-TIME CURVES FOR TEMPERED, SANDBLASTED, CGW 1723 SPECIMENS UNDER SUSTAINED LOAD.

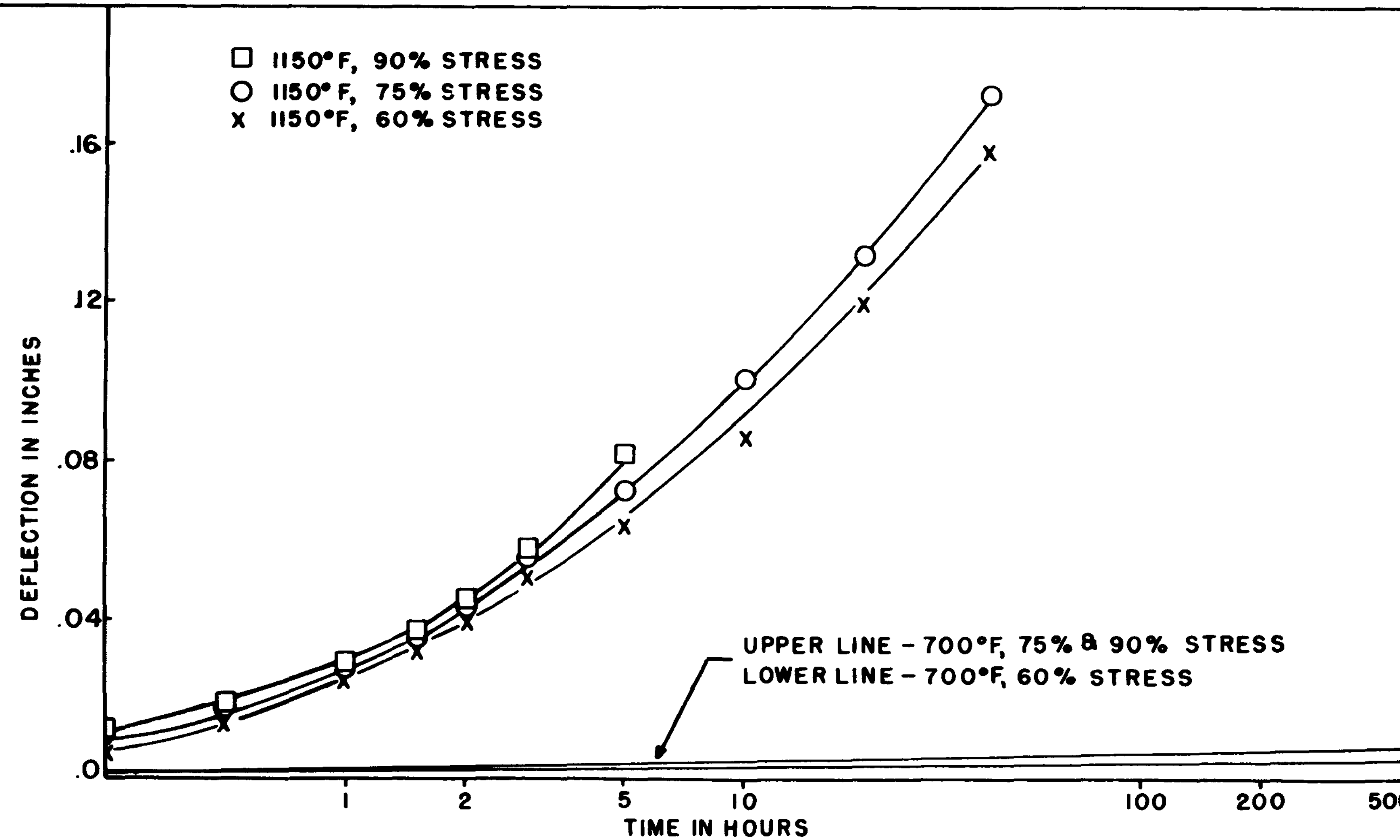

FIGURE 14. DEFLECTION - TIME CURVES FOR TEMPERED, SANDBLASTED, CGW 1723 SPECIMENS UNDER SUSTAINED LOAD.

Stress-Rupture and Creep of CGW 7740

The results of stress-rupture tests made at 75°F on annealed and semi-tempered CGW 7740 specimens are presented in Figure 14. The results for annealed specimens show there were no failures in 500 hours at 45% stress, but failures occurred at 60% stress and 75% stress at 75°F. At 700°F there were no failures at 45% stress but failures occurred at 60% and 75% stress. At 870°F there were no failures at 45% and 60% stress but failures occurred at 75% stress.

The results for the semi-tempered specimens show no failures at 60% stress, but failures occurred at 75% and 90% stress at 75°F. At 700°F there were no failures but at 870°F there were failures at all three stress levels.

Creep was noted for both annealed and semi-tempered specimens at both 700°F and 870°F at all three stress levels. The annealed creep curves are presented in Figures 15 and 16; the semi-tempered creep curves in Figures 17 and 18.

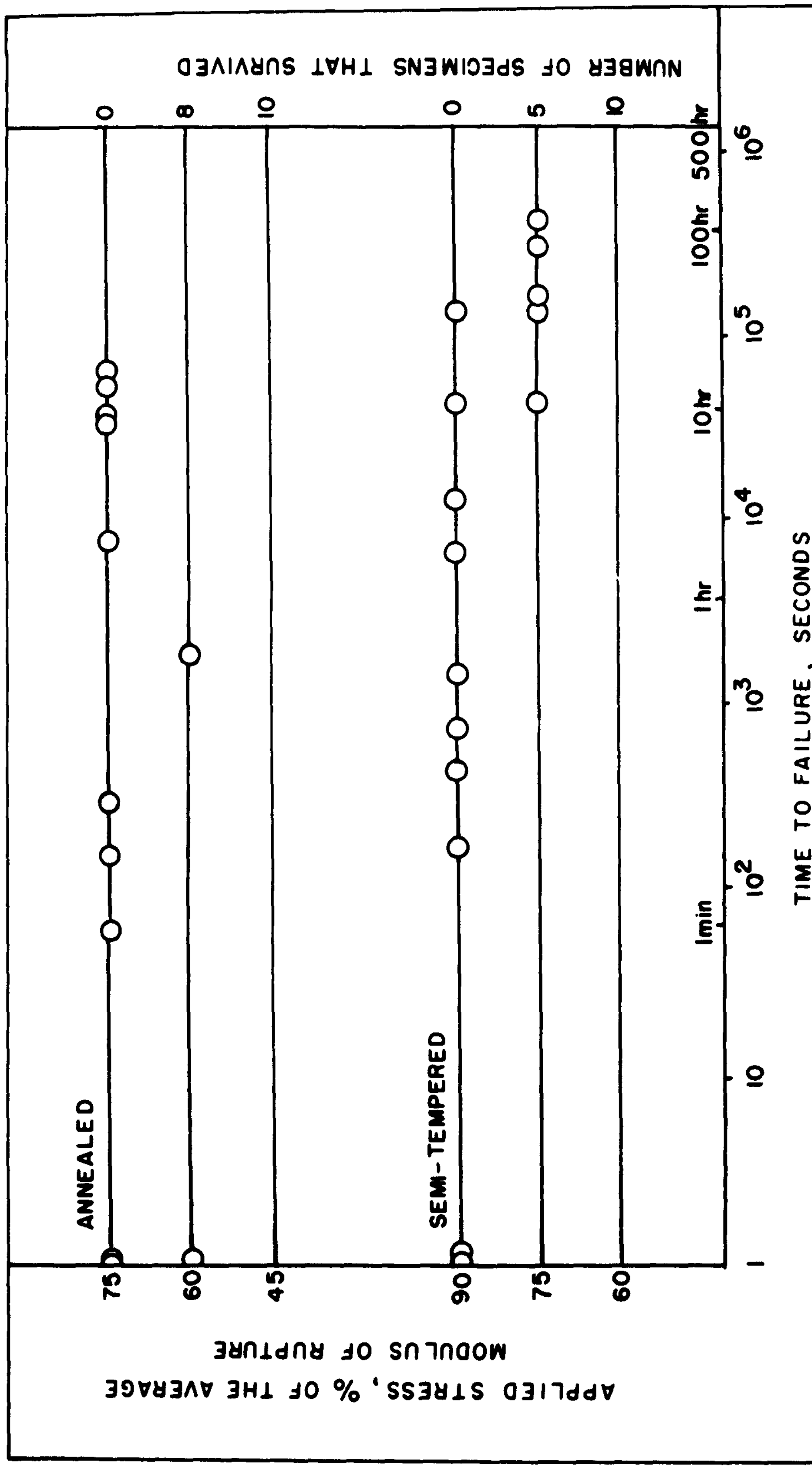

FIGURE 15. TIME TO FAILURE FOR CGW 7740 SPECIMENS UNDER SUSTAINED LOAD AT 75° F.

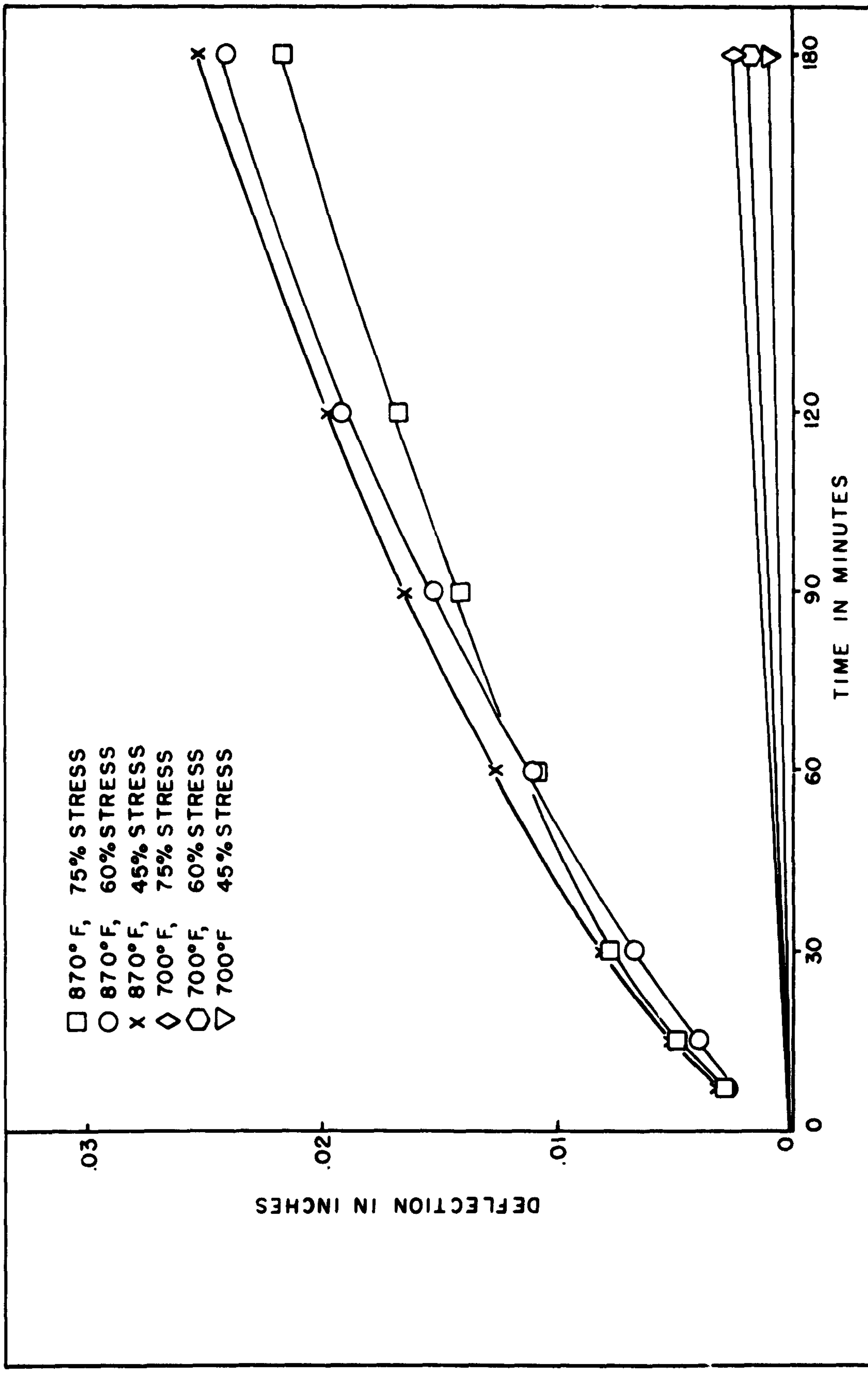

FIGURE 16 DEFLECTION-TIME CURVES FOR ANNEALED, SANDBLASTED, CGW 7740 SPECIMENS UNDER SUSTAINED LOAD.

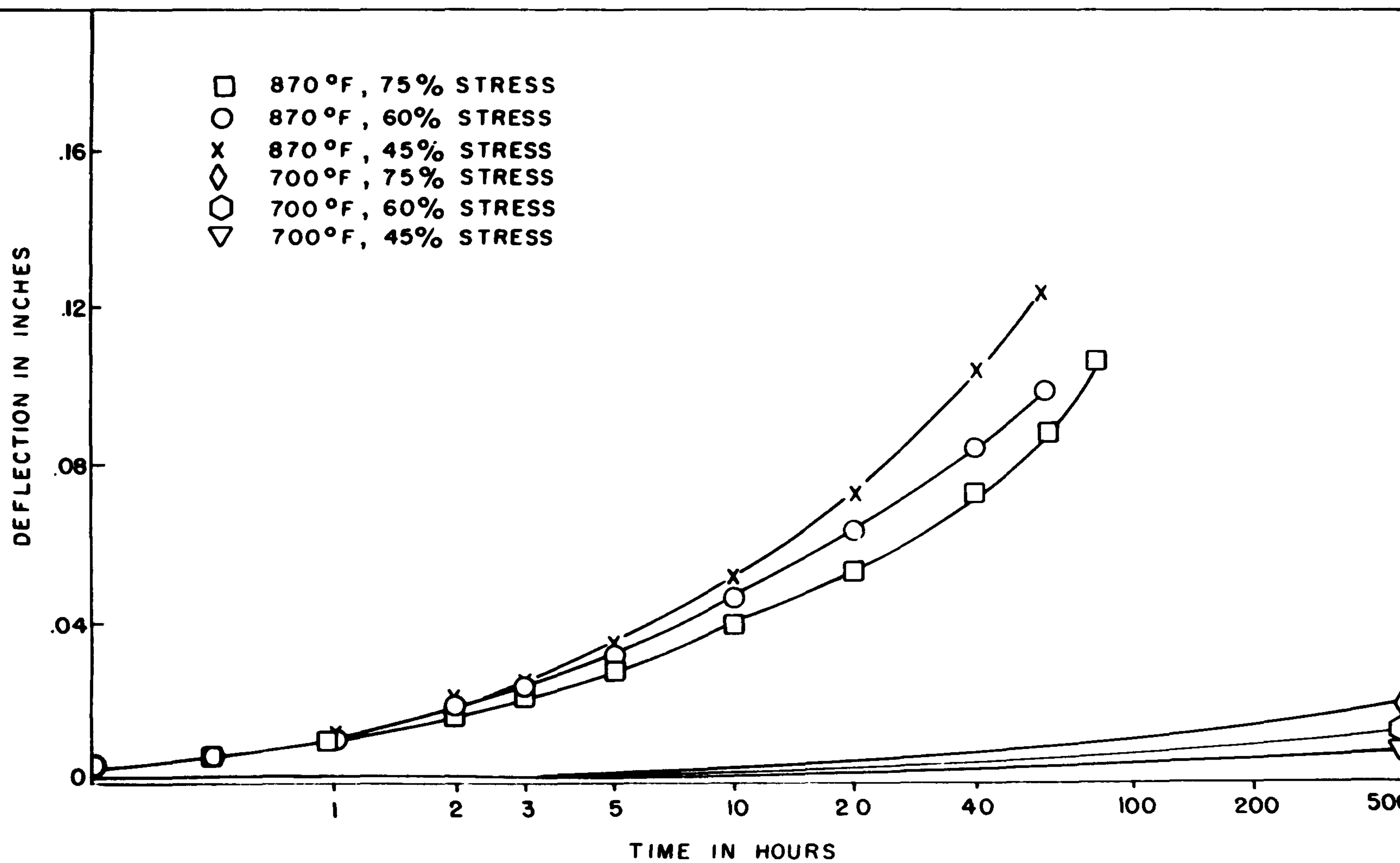

FIGURE 17 DEFLECTION-TIME CURVES FOR ANNEALED, SANDBLASTED, CGW 7740 SPECIMENS UNDER SUSTAINED LOAD.

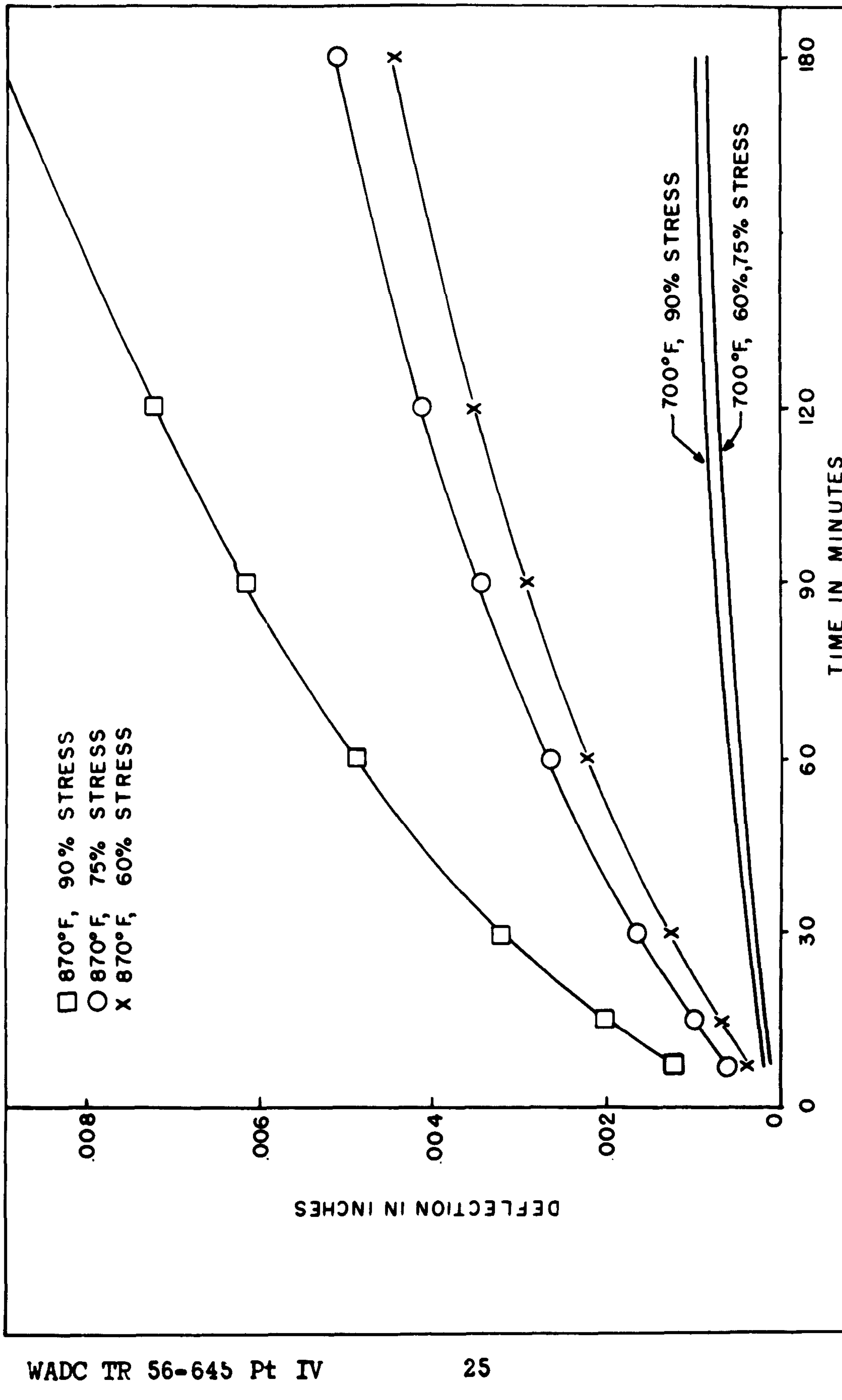

FIGURE 18 DEFLECTION - TIME CURVES FOR SEMI-TEMPERED, SANDBLASTED, CGW 7740 SPECIMENS UNDER SUSTAINED LOAD.

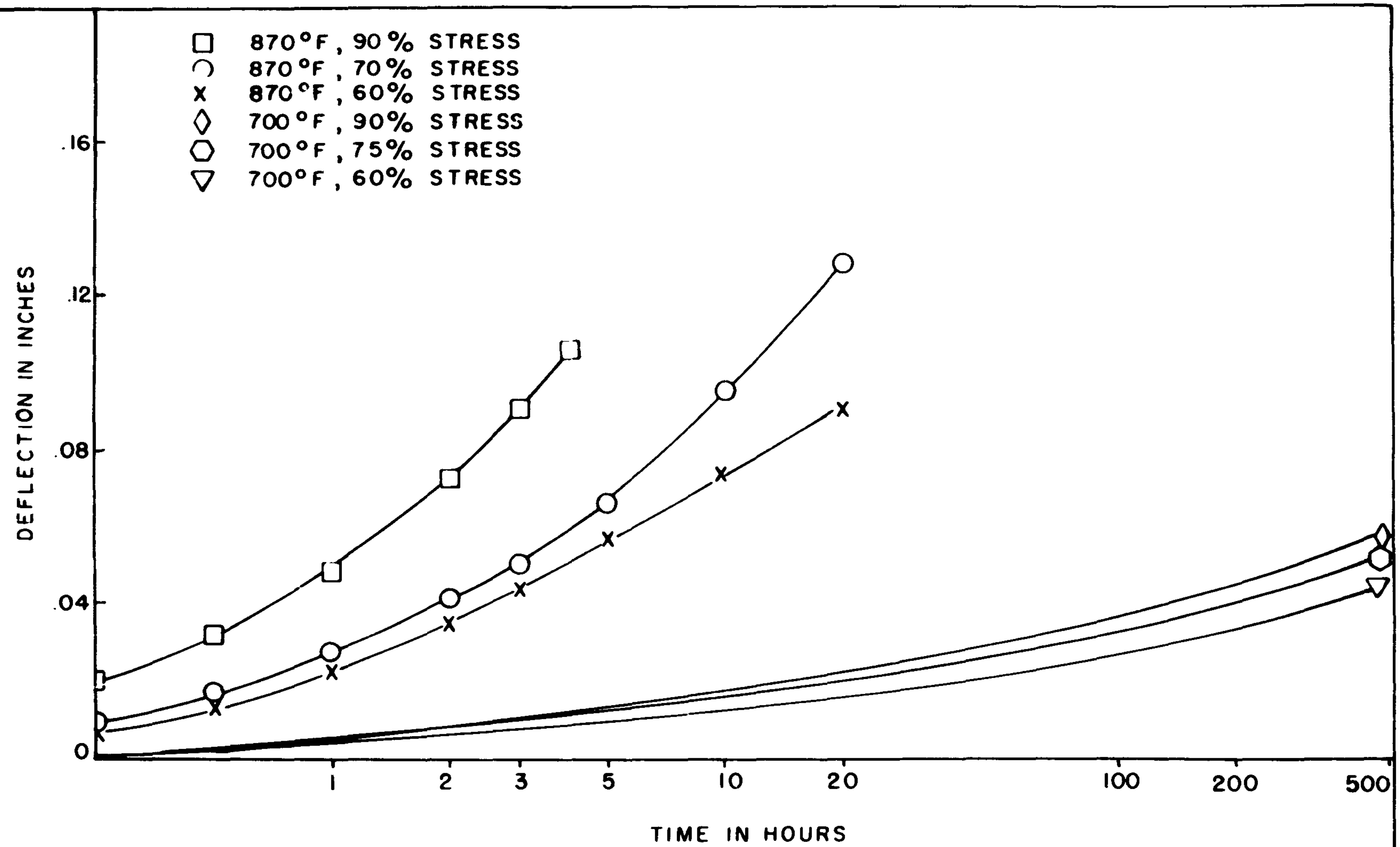

FIGURE 17. DEFLECTION-TIME CURVES FOR SEMI-TEMPERED, SANDBLASTED, CGW 7740 SPECIMENS UNDER SUSTAINED LOAD.

The Effect of the Rate of Loading on the Modulus of Rupture

The modulus of rupture was determined on groups of 15 annealed, sandblasted specimens of PPG glass tested at several rates of loading. The specimens were from the same lot, and were the same size as those used in the work previously reported (2). The testing was conducted at 75°F on the same apparatus and with the same techniques as used for the other modulus of rupture work. A graph of the results obtained is shown in Figure 20. In addition to the NBS data the data of Black (3) and Orr (4) are presented for comparison. The data presented by Black and Orr were obtained on ground and polished specimens of a different size than used for the NBS work. However, the interesting point is that although all three curves show a decrease in strength with a decrease in loading rate, the rate of decrease for the ground and polished specimens is much greater than for the sandblasted specimens.

Table II gives the location of the fracture origin, the average modulus of rupture and the standard deviation for the various loading rates. Differences, at the 5% level of significance, between the moduli of rupture at the various loading rates are also listed in this table. Detailed results are given in Appendix II.

A linear equation was fitted to the modulus of rupture - rate of loading data. The equation developed is:

$$\text{Modulus of Rupture} = 4555 + 533 \cdot \log[\text{loading rate}]$$

The modulus of rupture is in psi and the loading rate is in psi/min. The 95% confidence limit for the slope is 533 ± 208.

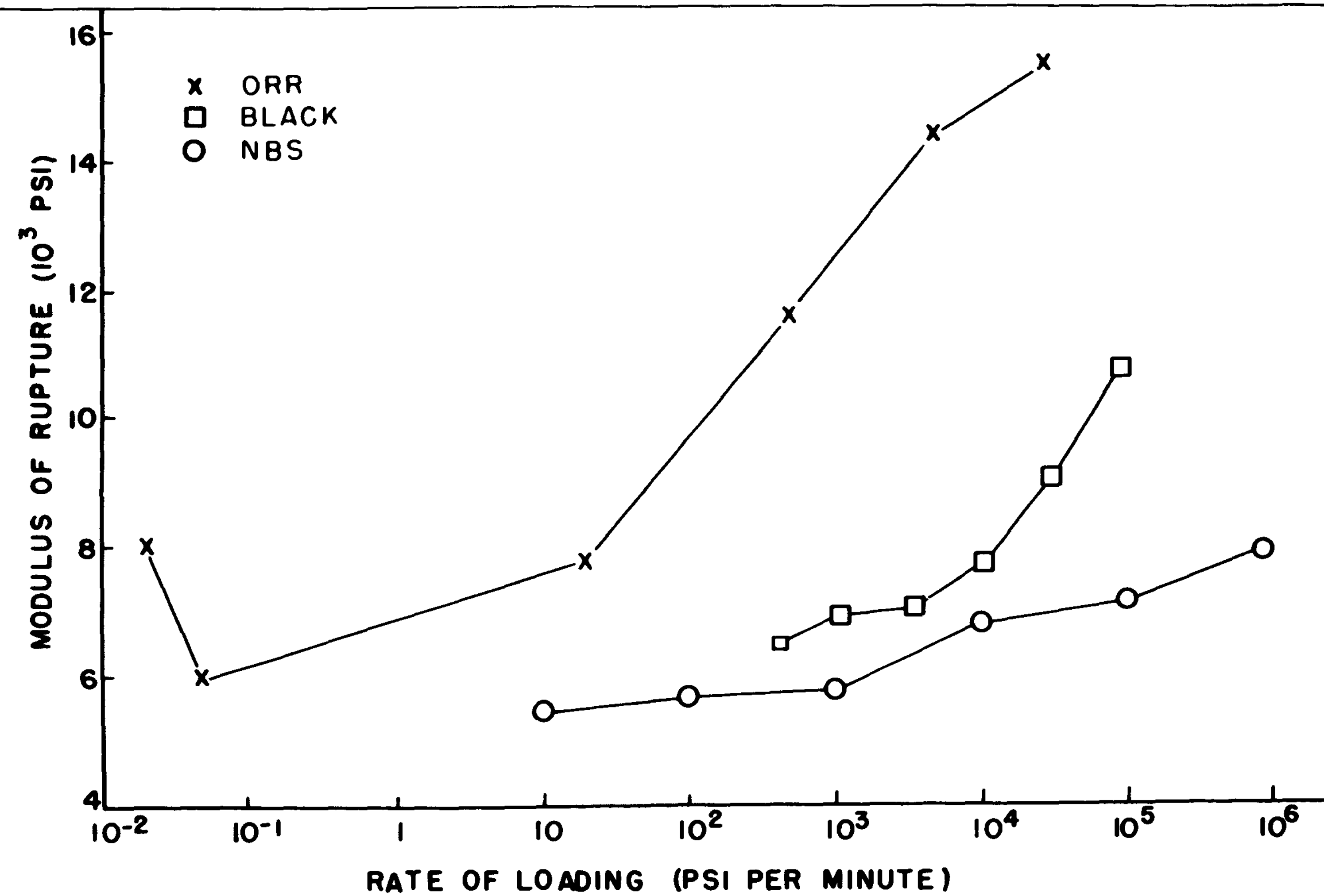

FIGURE 2?. THE EFFECT OF THE RATE OF LOADING ON THE MODULUS OF RUPTURE OF ANNEALED, SANDBLASTED PPG 3235 SPECIMENS.

Table II. Average Modulus of Rupture for Annealed, Sandblasted, PPG 3235 Specimens Loaded at Different Rates

Rate of Loading psi/min	Location of Breaks 1/	Modulus of Rupture			Mirror Radius			Significant Differences at the 5% Level psi/min
		n 2/	$\bar{x}$ 3/ psi	S.D. 4/ psi	n	$\bar{x}$ Inches	S.D. Inches	
10	S	12	5400	479	12	0.176	0.0488	10 < 10,000
	E	3	5500	-				10 < 100,000
100	S	14	5600	661	14	0.152	0.0552	10 < 1,000,000
	E	1	4300	-				100 < 10,000
1,000	S	14	5800	576	14	0.145	0.0386	100 < 100,000
	E	1	4700	-				100 < 1,000,000
10,000	S	14	6800	650	14	0.091	0.0220	1,000 < 10,000
	E	1	5300	-				1,000 < 100,000
100,000	S	15	7200	611	15	0.057	0.0110	1,000 < 1,000,000
	E	0	-	-				10,000 < 1,000,000
1,000,000	S	14	8000	359	10	0.043	0.0047	100,000 < 1,000,000
	E	1	7800	-				

1/ S - Origin of break on surface of specimen.
E - Origin of break on edge of specimen.

2/ n - Number of specimens.

3/ $\bar{x}$ - Average.

4/ S.D. - Standard deviation.

The average mirror radius[1] is also presented in Table II. It can readily be seen that as the strength increases the mirror size decreases. A log-log plot of the individual mirror sizes versus the modulus of rupture, Figure 21, shows they tend to fall on a straight line similar to the results previously reported for an annealed glass (2). This would seem to show the rate of loading has no apparent effect on the mirror size. However, since the loading rate does affect the strength which in turn affects the mirror size,

the linear equation

Mirror size = 0.2305 -(.0341)log(loading rate)

where mirror size is in inches and loading rate is in psi per minute, fits the data.

The 95% confidence interval for the slope is -.0341 ± .0128

1/ Mirror radius was determined by measuring, along the edge of the fracture face that was in tension, the length of the smooth, or mirror, portion of the fracture face and dividing by 2.

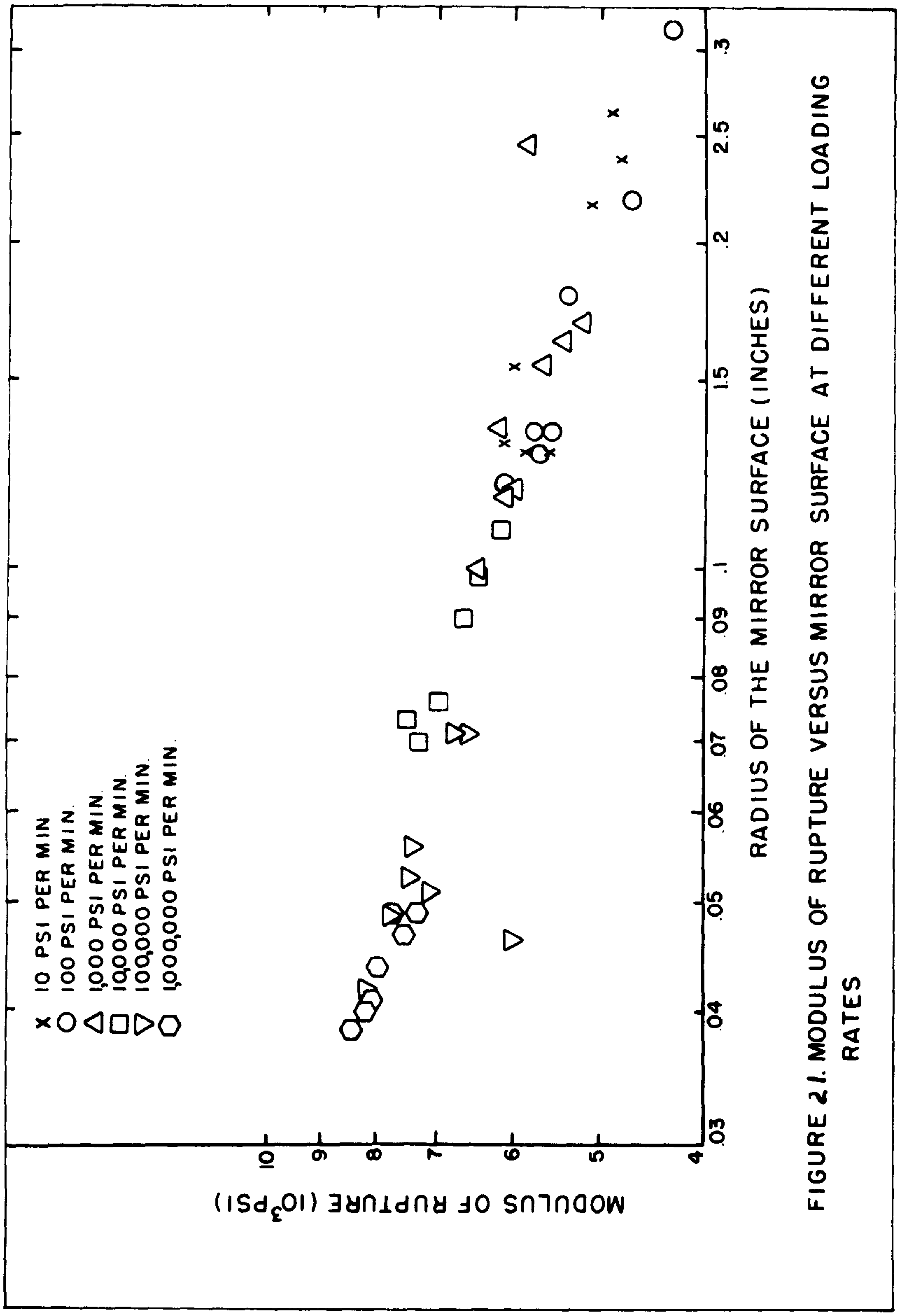

FIGURE 21. MODULUS OF RUPTURE VERSUS MIRROR SURFACE AT DIFFERENT LOADING RATES

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(2) Kerper, M.J., Diller, C.C., and Eimer, E.H., "Properties of Glasses at Elevated Temperatures, Part II." WADC Technical Report 56-645 Part II. December 1957.

(3) Black, L.V., "Effect of the Rate of Loading on the Breaking Strength of Glass." Bull. Amer. Ceram. Soc. Vol. 15 pp 274-275 (1936).

(4) Private communication, Leighton Orr.

APPENDIX I

INDIVIDUAL RESULTS FOR STRESS-RUPTURE TESTS

The individual results for the stress-rupture work on PPG 3235, CGW 1723, and CGW 7740 are presented here in Tables III through XXVI. The columns in the tables are titled with Roman numerals and the information under them is:

Column:

I. Identification number of specimens.

II. Time in seconds that specimen sustained load before breaking. When an asterisk (*) is in this column the specimen did not creep or break in 500 hours. When C is shown in this column the specimen crept; in 500 hrs or less. In the tests made at 50°C below the strain point, the specimen was invariably removed before 500 hours because creep became excessive for the apparatus. When a number followed by C is shown, the specimen crept before breaking in the indicated time.

III. Fracture origin. S - fracture originated on the surface of the specimen. E - fracture originated on the edge of the specimen.

IV. Radius of the mirror portion of the fracture surface in inches.

V. Distance of the fracture origin from one end of the specimen. A distance of four inches indicates that the fracture was directly below one of the loading knife edges while a distance from four to five inches indicates that fracture occurred between the two loading knife edges.

Table III. Individual stress-rupture results for PPG 3235 annealed, sandblasted specimens tested at 75°F

45% Stress (3,005 psi)

I	II	III	IV	V
214	2,700	E	-	4-1/2
284	738,900	S	-	5.0
15	*	-	-	-
16	*	-	-	-
64	*	-	-	-
65	*	-	-	-
114	*	-	-	-
115	*	-	-	-
164	*	-	-	-
215	*	-	-	-

60% Stress (4,005 psi)

I	II	III	IV	V
216	3,666	S	-	5.0
167	36,780	E	-	4.0
217	78,460	S	.388	5.0
17	129,480	S	.217	5.0
166	779,880	S	.492	4-1/2
18	*	-	-	-
66	*	-	-	-
67	*	-	-	-
116	*	-	-	-
117	*	-	-	-

75% Stress (5,010 psi)

I	II	III	IV	V
119	6	S	.147	5.0
218	36	S	.020	5.0
219	42	S	.409	3-1/2
168	42	S	.205	4-1/4
169	140	S	.211	4-3/4
20	180	S	.206	4-3/4
68	180	S	.250	4.00
118	180	S	.372	4-1/2
19	600	S	.278	5.00
69	2,700	S	.230	5.00

Table IV. Individual stress-rupture results for PPG 3235 annealed, sandblasted specimens tested at 700°F

45% Stress (2,870 psi)

I	II	III	IV	V
21	c	-	-	-
22	c	-	-	-
70	c	-	-	-
71	c	-	-	-
120	c	-	-	-
121	c	-	-	-
170	c	-	-	-
171	c	-	-	-
220	c	-	-	-
221	c	-	-	-

60% Stress (3,830 psi)

I	II	III	IV	V
173	180	E	-	5.00
223	2,040	S	.260	4.00
23	c	-	-	-
24	[illegible]	-	-	-
72	c	-	-	-
73	c	-	-	-
122	c	-	-	-
123	c	-	-	-
172	c	-	-	-
222	c	-	-	-

75% Stress (4,785 psi)

I	II	III	IV	V
25	c	-	-	-
26	c	-	-	-
74	c	-	-	-
75	c	-	-	-
124	c	-	-	-
125	c	-	-	-
174	c	-	-	-
175	c	-	-	-
224	c	-	-	-
225	c	-	-	-

Table V. Individual stress-rupture results for PPG 3235 annealed, sandblasted specimens tested at 830°F

45% Stress (3,045 psi)

I	II	III	IV	V
27	c	-	-	-
82	c	-	-	-
76	c	-	-	-
77	c	-	-	-
126	c	-	-	-
127	c	-	-	-
176	c	-	-	-
177	c	-	-	-
222	c	-	-	-
227	c	-	-	-

60% Stress (4,060 psi)

I	II	III	IV	V
78	716,700c	S	.020	5.00
83	c	-	-	-
84	c	-	-	-
85	c	-	-	-
128	c	-	-	-
129	c	-	-	-
178	c	-	-	-
179	c	-	-	-
228	c	-	-	-
229	c	-	-	-

75% Stress (5,075 psi)

I	II	III	IV	V
81	80	E	-	5.00
80	c	-	-	-
87	c	-	-	-
130	c	-	-	-
180	c	-	-	-
181	c	-	-	-
230	c	-	-	-
231	c	-	-	-
281	c	-	-	-
282	c	-	-	-

Table VI. Individual stress-rupture results for PPG 3235 semi-tempered, sandblasted specimens tested at 75°F

70% Stress (9,365 psi)

I	II	III	IV	V
416	*	-	-	-
417	*	-	-	-
464	*	-	-	-
465	*	-	-	-
514	*	-	-	-
515	*	-	-	-
564	*	-	-	-
565	*	-	-	-
614	*	-	-	-
615	*	-	-	-

80% Stress (10,705 psi)

I	II	III	IV	V
599	156,000	E	-	5.00
418	*	-	-	-
419	*	-	-	-
466	*	-	-	-
467	*	-	-	-
516	*	-	-	-
517	*	-	-	-
567	*	-	-	-
616	*	-	-	-
617	*	-	-	-

90% Stress (12,040 psi)

I	II	III	IV	V
469	158	-	-	-
519	360	-	-	-
421	601	-	-	-
518	71,400	-	-	-
618	149,040	-	-	-
468	244,680	-	-	-
420	1,642,200	-	-	-
568	*	-	-	-
569	*	-	-	-
619	*	-	-	-

Table VII. Individual stress-rupture results for PPG 3235 semi-tempered, sandblasted specimens tested at 700°F

70% Stress (8,065 psi)

I	II	III	IV	V
422	c	-	-	-
423	c	-	-	-
470	c	-	-	-
471	c	-	-	-
520	c	-	-	-
521	c	-	-	-
570	c	-	-	-
571	c	-	-	-
620	c	-	-	-
621	c	-	-	-

80% Stress (9,215 psi)

I	II	III	IV	V
424	c	-	-	-
425	c	-	-	-
472	c	-	-	-
473	c	-	-	-
522	c	-	-	-
523	c	-	-	-
572	c	-	-	-
573	c	-	-	-
622	c	-	-	-
623	c	-	-	-

90% Stress (10,370 psi)

I	II	III	IV	V
426	c	-	-	-
427	c	-	-	-
474	c	-	-	-
475	c	-	-	-
524	c	-	-	-
525	c	-	-	-
574	c	-	-	-
575	c	-	-	-
624	c	-	-	-
625	c	-	-	-

Table VIII. Individual stress-rupture results for PPG 3235 semi-tempered, sandblasted specimens tested at 830°F

70% Stress (6,795 psi)

I	II	III	IV	V
526	4,500c	S		5.00
428	c	-	-	-
429	c	-	-	-
493	c	-	-	-
477	c	-	-	-
527	c	-	-	-
576	c	-	-	-
577	c	-	-	-
626	c	-	-	-
627	c	-	-	-

80% Stress (7,770 psi)

I	II	III	IV	V
430	c	-	-	-
431	c	-	-	-
478	c	-	-	-
479	c	-	-	-
528	c	-	-	-
529	c	-	-	-
578	c	-	-	-
598	c	-	-	-
628	c	-	-	-
629	c	-	-	-

90% Stress (8,740 psi)

I	II	III	IV	V
432	c	-	-	-
433	c	-	-	-
480	c	-	-	-
481	c	-	-	-
530	c	-	-	-
531	c	-	-	-
580	c	-	-	-
581	c	-	-	-
630	c	-	-	-
631	c	-	-	-

Table IX. Individual stress-rupture results for PPG 3235 tempered, sandblasted specimens tested at 75°F

70% Stress (15,240 psi)

I	II	III	IV	V
816	*	-	-	-
817	*	-	-	-
864	*	-	-	-
865	*	-	-	-
914	*	-	-	-
915	*	-	-	-
965	*	-	-	-
967	*	-	-	-
1015	*	-	-	-
1016	*	-	-	-

80% Stress (17,415 psi)

I	II	III	IV	V
818	*	-	-	-
819	*	-	-	-
866	*	-	-	-
867	*	-	-	-
916	*	-	-	-
917	*	-	-	-
968	*	-	-	-
969	*	-	-	-
1017	*	-	-	-
1018	*	-	-	-

90% Stress (19,595 psi)

I	II	III	IV	V
821	300	-	-	-
918	300	-	-	-
869	600	-	-	-
820	3,000	-	-	-
1020	11,580	-	-	-
868	1,234,080	-	-	-
1019	1,234,600	-	-	-
919	*	-	-	-
970	*	-	-	-
971	*	-	-	-

Table X. Individual stress-rupture results for PPG 3235 tempered, sandblasted specimens tested at 700°F

70% Stress (8,815 psi)

I	II	III	IV	V
822	c	-	-	-
823	c	-	-	-
870	c	-	-	-
871	c	-	-	-
920	c	-	-	-
921	c	-	-	-
972	c	-	-	-
973	c	-	-	-
1021	c	-	-	-
1022	c	-	-	-

80% Stress (10,070 psi)

I	II	III	IV	V
824	c	-	-	-
825	c	-	-	-
872	c	-	-	-
873	c	-	-	-
922	c	-	-	-
923	c	-	-	-
974	c	-	-	-
975	c	-	-	-
1023	c	-	-	-
1024	c	-	-	-

90% Stress (11,330 psi)

I	II	III	IV	V
827	126,000c	-	-	-
878	201,600c	-	-	-
924	523,380c	-	-	-
826	c	-	-	-
875	c	-	-	-
925	c	-	-	-
976	c	-	-	-
977	c	-	-	-
1025	c	-	-	-
1026	c	-	-	-

Table XI. Individual stress-rupture results for PPG 3235 tempered, sandblasted specimens tested at 830°F

70% Stress (6,230 psi)

I	II	III	IV	V
927	37,500c	-	-	-
828	c	-	-	-
829	c	-	-	-
876	c	-	-	-
877	c	-	-	-
926	c	-	-	-
978	c	-	-	-
979	c	-	-	-
1027	c	-	-	-
1028	c	-	-	-

80% Stress (7,120 psi

I	II	III	IV	V
879	169,200c	-	-	-
830	c	-	-	-
831	c	-	-	-
880	c	-	-	-
928	c	-	-	-
929	c	-	-	-
980	c	-	-	-
981	c	-	-	-
1029	c	-	-	-
1030	c	-	-	-

90% Stress (8,010 psi)

I	II	III	IV	V
1031	1,860c	-	-	-
832	c	-	-	-
833	c	-	-	-
881	c	-	-	-
882	c	-	-	-
930	c	-	-	-
931	c	-	-	-
982	c	-	-	-
983	c	-	-	-
1032	c	-	-	-

Table XII. Individual stress-rupture results for CGW 1723 annealed, sandblasted specimens tested at 75°F

45% Stress (2,985 psi)

I	II	III	IV	V
115	1,800	E	-	3-3/4
113	16,200	E	-	4-1/2
106	*	-	-	-
107	*	-	-	-
108	*	-	-	-
109	*	-	-	-
110	*	-	-	-
111	*	-	-	-
112	*	-	-	-
114	*	-	-	-

60% Stress (3,980 psi)

I	II	III	IV	V
118	900	E	-	4-3/4
119	6,600	S	.578	4.0
116	40,980	S	.433	5.0
125	81,360	S	.718	4.0
123	313,740	S	.567	4-1/2
117	440,000	S	.336	5.0
124	1,374,540	S	1.130	4.0
120	*	-	-	-
121	*	-	-	-
122	*	-	-	-

75% Stress (4,970 psi)

I	II	III	IV	V
129	246	S	.310	4-1/4
132	300	S	.103	4-1/4
133	300	S	.517	3-1/2
127	600	S	.264	3-3/4
134	4,080	S	.294	5.0
130	5,820	S	.969	3-1/4
135	76,800	S	.331	5.0
131	205,620	E	-	4.0
126	478,500	S	.312	4-1/2
128	587,160	E	-	4-1/2

Table XIII. Individual stress-rupture results for CGW 1723 annealed, sandblasted specimens tested at 700°F

45% Stress (2,740 psi)

I	II	III	IV	V
136	*	-	-	-
137	*	-	-	-
138	*	-	-	-
139	*	-	-	-
140	*	-	-	-
141	*	-	-	-
142	*	-	-	-
143	*	-	-	-
144	*	-	-	-
145	*	-	-	-

60% Stress (3,655 psi)

I	II	III	IV	V
146	*	-	-	-
147	*	-	-	-
148	*	-	-	-
149	*	-	-	-
150	*	-	-	-
151	*	-	-	-
152	*	-	-	-
153	*	-	-	-
154	*	-	-	-
155	*	-	-	-

75% Stress (4,570 psi)

I	II	III	IV	V
158	O	E	-	5.0
156	*	-	-	-
157	*	-	-	-
159	*	-	-	-
160	*	-	-	-
161	*	-	-	-
162	*	-	--	-
163	*	-	-	-
164	*	-	-	-
165	*	-	-	-

Table XIV. Individual stress-rupture results for CGW 1723 annealed, sandblasted specimens tested at 1150°F

45% Stress (3,505 psi)

I	II	III	IV	V
166	c	-	-	-
167	c	-	-	-
168	c	-	-	-
169	c	-	-	-
170	c	-	-	-
171	c	-	-	-
172	c	-	-	-
173	c	-	-	-
174	c	-	-	-
175	c	-	-	-

60% Stress (4,675 psi)

I	II	III	IV	V
180	622,200c	E	-	5.0
176	c	-	-	-
177	c	-	-	-
178	c	-	-	-
179	c	-	-	-
181	c	-	-	-
182	c	-	-	-
183	c	-	-	-
184	c	-	-	-
185	c	-	-	-

75% Stress (5,840 psi)

I	II	III	IV	V
188	66	S	.134	4-3/4
190	1,800	S	.144	4-1/2
186	96,000c	E	-	5.0
187	c	-	-	-
189	c	-	-	-
191	c	-	-	-
192	c	-	-	-
193	c	-	-	-
194	c	-	-	-
195	c	-	-	-

Table XV. Individual stress-rupture results for CGW 1723 semi-tempered, sandblasted specimens tested at 75°F

60% Stress (10,790 psi)

I	II	III	IV	V
352	229,200	S	-	5.00
346	*	-	-	-
347	*	-	-	-
348	*	-	-	-
349	*	-	-	-
350	*	-	-	-
351	*	-	-	-
353	*	-	-	-
354	*	-	-	-
355	*	-	-	-

75% Stress (13,485 psi)

I	II	III	IV	V
365	121	S	.070	5.00
361	28,620	S	-	5.00
363	47,520	S	-	5.00
357	217,020	S	-	4-3/4
356	474,900	S	-	4-3/4
358	*	-	-	-
359	*	-	-	-
360	*	-	-	-
362	*	-	-	-
364	*	-	-	-

90% Stress (16,180 psi)

I	II	III	IV	V
367	o	S	.054	5.0
368	o	S	.052	5.0
369	o	S	.045	5.0
370	o	S	-	5.0
371	o	S	-	5.0
373	62	S	-	4-3/4
366	65	S	-	4-1/2
375	66	S	-	5.0
374	357	S	-	5.0
372	785	S	-	4-3/4

Table XVI. Individual stress-rupture results for CGW 1723 semi-tempered, sandblasted specimens tested at 700°F

60% Stress (9,810 psi)

I	II	III	IV	V
376	c	-	-	-
377	c	-	-	-
378	c	-	-	-
379	c	-	-	-
380	c	-	-	-
381	c	-	-	-
382	c	-	-	-
383	c	-	-	-
384	c	-	-	-
385	c	-	-	-

75% Stress (12,265 psi)

I	II	III	IV	V
386	c	-	-	-
387	c	-	-	-
388	c	-	-	-
389	c	-	-	-
390	c	-	-	-
391	c	-	-	-
392	c	-	-	-
393	c	-	-	-
394	c	-	-	-
395	c	-	-	-

90% Stress (14,715 psi)

I	II	III	IV	V
403	61	S	.049	4-1/4
396	c	-	-	-
397	c	-	-	-
398	c	-	-	-
399	c	-	-	-
400	c	-	-	-
401	c	-	-	-
402	c	-	-	-
404	c	-	-	-
405	c	-	-	-

Table XVII. Individual stress-rupture results for CGW 1723 semi-tempered, sandblasted specimens tested at 1150°F

60% Stress (6,510 psi)

I	II	III	IV	V
406	c	-	-	-
407	c	-	-	-
408	c	-	-	-
409	c	-	-	-
410	c	-	-	-
411	c	-	-	-
412	c	-	-	-
413	c	-	-	-
414	c	-	-	-
415	c	-	-	-

75% Stress (8,140 psi)

I	II	III	IV	V
416	c	-	-	-
417	c	-	-	-
418	c	-	-	-
419	c	-	-	-
420	c	-	-	-
421	c	-	-	-
422	c	-	-	-
423	c	-	-	-
424	c	-	-	-
425	c	-	-	-

90% Stress (9,765 psi)

I	II	III	IV	V
426	60	S	-	5.0
427	24,300c	S	-	5.0
428	c	-	-	-
429	c	-	-	-
430	c	-	-	-
431	c	-	-	-
432	c	-	-	-
433	c	-	-	-
434	c	-	-	-
435	c	-	-	-

Table XVIII. Individual stress-rupture results for CGW 1723 tempered, sandblasted specimens tested at 75°F

60% Stress (14,370 psi)

I	II	III	IV	V
586	*	-	-	-
587	*	-	-	-
588	*	-	-	-
589	*	-	-	-
590	*	-	-	-
591	*	-	-	-
592	*	-	-	-
593	*	-	-	-
594	*	-	-	-
595	*	-	-	-

75% Stress (17,965) psi)

I	II	III	IV	V
596	*	-	-	-
597	*	-	-	-
598	*	-	-	-
599	*	-	-	-
600	*	-	-	-
601	*	-	-	-
602	*	-	-	-
603	*	-	-	-
604	*	-	-	-
605	*	-	-	-

90% Stress (21,555 psi)

I	II	III	IV	V
607	120	S	-	5.0
608	3,000	S	-	5.0
609	82,080	S	-	5.0
606	329,400	S	-	5.0
615	813,120	S	-	5.0
611	1,547,100	S	-	5.0
610	*	-	-	-
612	*	-	-	-
613	*	-	-	-
614	*	-	-	-

Table XIX. Individual stress-rupture results for CGW 1723 tempered, sandblasted specimens tested at 700°F

60% Stress (14,020 psi)

I	II	III	IV	V
616	c	-	-	-
617	c	-	-	-
618	c	-	-	-
619	c	-	-	-
620	c	-	-	-
621	c	-	-	-
622	c	-	-	-
623	c	-	-	-
624	c	-	-	-
625	c	-	-	-

75% Stress (17,530 psi)

I	II	III	IV	V
626	c	-	-	-
627	c	-	-	-
628	c	-	-	-
629	c	-	-	-
630	c	-	-	-
631	c	-	-	-
632	c	-	-	-
633	c	-	-	-
634	c	-	--	-
635	c	-	-	-

90% Stress (21,035 psi)

I	II	III	IV	V
636	c	-	-	-
637	c	-	-	-
638	c	-	-	-
639	c	-	-	-
640	c	-	-	-
641	c	-	-	-
642	c	-	-	-
643	c	-	-	-
644	c	-	-	-
645	c	-	-	-

Table XX. Individual stress-rupture results for CGW 1723 tempered, sandblasted specimens tested at 1150°F

60% Stress (6,270 psi)

I	II	III	IV	V
646	c	-	-	-
647	c	-	-	-
648	c	-	-	-
649	c	-	-	-
650	c	-	-	-
651	c	-	-	-
652	c	-	-	-
653	c	-	-	-
654	c	-	-	-
655	c	-	-	-

75% Stress (7,840 psi)

I	II	III	IV	V
656	c	-	-	-
657	c	-	-	-
658	c	-	-	-
659	c	-	-	-
660	c	-	-	-
661	c	-	-	-
662	c	-	-	-
663	c	-	-	-
664	c	-	-	-
665	c	-	-	-

90% Stress (9,405 psi)

I	II	III	IV	V
667	28,800c	S	-	5.0
668	46,800c	S	-	5.0
666	c	-	-	-
669	c	-	-	-
670	c	-	-	-
671	c	-	-	-
672	c	-	-	-
673	c	-	-	-
674	c	-	-	-
675	c	-	-	-

Table XXI. Individual stress-rupture results for CGW 7740 annealed, sandblasted specimens tested at 75°F

45% Stress (2,745 psi)

I	II	III	IV	V
121	*	-	-	-
122	*	-	-	-
123	*	-	-	-
124	*	-	-	-
125	*	-	-	-
126	*	-	-	-
127	*	-	-	-
128	*	-	-	-
129	*	-	-	-
130	*	-	-	-

60% Stress (3,660 psi)

I	II	III	IV	V
138	o	E	-	5.0
140	2,640	E	-	5.0
131	*	-	-	-
132	*	-	-	-
133	*	-	-	-
134	*	-	-	-
135	*	-	-	-
136	*	-	-	-
137	*	-	-	-
139	*	-	-	-

75% Stress (4,575 psi)

I	II	III	IV	V
141	o	E	-	5.0
143	o	E	-	5.0
149	62	S	.280	5.0
150	150	E	-	4-3/4
148	359	S	.218	5.0
144	85,740	S	-	5.0
142	339,300	E	-	5.0
145	391,680	S	.239	4-3/4
146	544,620	S	.114	4-3/4
147	632,220	S	.230	5.0

Table XXII. Individual stress-rupture results for CGW 7740 annealed, sandblasted specimens tested at 700°F

45% Stress (3,465 psi)

I	II	III	IV	V
151	c	-	-	-
152	c	-	-	-
153	c	-	-	-
154	c	-	-	-
155	c	-	-	-
156	c	-	-	-
157	c	-	-	-
158	c	-	-	-
159	c	-	-	-
160	c	-	-	-

60% Stress 4,620 psi)

I	II	III	IV	V
163	o	E	-	5.0
165	1,140	E	-	5.0
161	c	-	-	-
162	c	-	-	-
164	c	-	-	-
166	c	-	-	-
167	c	-	-	-
168	c	-	-	-
169	c	-	-	-
170	c	-	-	-

75% Stress (5,775 psi)

I	II	III	IV	V
176	o	E	-	4.00
174	62	E	-	3.75
173	180	E	-	5.00
175	1,680	S	.111	5.0
171	42,300c	S	.138	5.0
172	c	-	-	-
177	c	-	-	-
178	c	-	-	-
179	c	-	-	-
180	c	-	-	-

Table XXIII. Individual stress-rupture results for CGW 7740 annealed, sandblasted specimens tested at 870°F

45% Stress (3,645 psi)

I	II	III	IV	V
181	c	-	-	-
182	c	-	-	-
183	c	-	-	-
184	c	-	-	-
185	c	-	-	-
186	c	-	-	-
187	c	-	-	-
188	c	-	-	-
189	c	-	-	-
190	c	-	-	-

60% Stress (4,860 psi)

I	II	III	IV	V
191	c	-	-	-
192	c	-	-	-
193	c	-	-	-
194	c	-	-	-
195	c	-	-	-
196	c	-	-	-
197	c	-	-	-
198	c	-	-	-
199	c	-	-	-
200	c	-	-	-

75% Stress (6,075 psi)

I	II	III	IV	V
207	4,020c	E	-	5.0
205	5,400c	E	-	5.0
201	6,600c	E	-	5.0
210	11,400c	E	-	5.0
209	728,100c	E	-	5.0
202	c	-	-	-
203	c	-	-	-
204	c	-	-	-
206	c	-	-	-
208	c	-	-	-

Table XXIV. Individual stress rupture results for CGW 7740 semi-tempered, sandblasted specimens tested at 75°F

60% Stress (7,140 psi)

I	II	III	IV	V
361	*	-	-	-
362	*	-	-	-
363	*	-	-	-
364	*	-	-	-
365	*	-	-	-
366	*	-	-	-
367	*	-	-	-
368	*	-	-	-
369	*	-	-	-
370	*	-	-	-

75% Stress (8,925 psi)

I	II	III	IV	V
375	41,940	S	-	5.0
380	152,100	S	.106	5.0
373	183,420	E	-	5.0
378	301,140	S	.106	5.0
371	465,600	S	.106	5.0
372	*	-	-	-
374	*	-	-	-
376	*	-	-	-
377	*	-	-	-
379	*	-	-	-

90% Stress (10,710 psi)

I	II	III	IV	V
381	o	S	-	5.0
383	o	S	-	5.0
384	180	S	-	5.0
390	420	S	-	5.0
386	842	S	-	5.0
385	1,620	S	.082	5.0
389	6,240	S	-	5.0
388	12,600	S	-	5.0
382	43,905	S	-	5.0
387	150,900	S	.086	5.0

Table XXV. Individual stress-rupture results for CGW 7740 semi-tempered, sandblasted specimens tested at 700°F

60% Stress (6,720 psi)

I	II	III	IV	V
391	c	-	-	-
392	c	-	-	-
393	c	-	-	-
394	c	-	-	-
395	c	-	-	-
396	c	-	-	-
397	c	-	-	-
398	c	-	-	-
399	c	-	-	-
400	c	-	-	-

75% Stress (8,400 psi)

I	II	III	IV	V
401	c	-	-	-
402	c	-	-	-
403	c	-	-	-
404	c	-	-	-
405	c	-	-	-
406	c	-	-	-
407	c	-	-	-
408	c	-	-	-
409	c	-	-	-
410	c	-	-	-

90% Stress (10,080 psi)

I	II	III	IV	V
411	c	-	-	-
412	c	-	-	-
413	c	-	-	-
414	c	-	-	-
415	c	-	-	-
416	c	-	-	-
417	c	-	-	-
418	c	-	-	-
419	c	-	-	-
420	c	-	-	-

Table XXVI. Individual stress-rupture results for CGW 7740 semi-tempered, sandblasted specimens tested at 870°F

60% Stress (6,540 psi)

I	II	III	IV	V
423	67,200c	E	-	5.0
425	126,900c	E	-	5.0
421	c	-	-	-
422	c	-	-	-
425	c	-	-	-
426	c	-	-	-
427	c	-	-	-
428	c	-	-	-
429	c	-	-	-
430	c	-	-	-

75% Stress (8,175 psi)

I	II	III	IV	V
431	19,800c	-	-	-
432	c	-	-	-
433	c	-	-	-
434	c	-	-	-
435	c	-	-	-
436	c	-	-	-
437	c	-	-	-
438	c	-	-	-
439	c	-	-	-
440	c	-	-	-

90% Stress (9,810)

I	II	III	IV	V
442	o	E	-	5.0
441	128	E	-	5.0
450	6,120c	S	-	5.0
447	17,100c	E	-	5.0
444	18,900c	E	-	5.0
443	33,300c	E	-	5.0
445	51,900c	S	-	5.0
446	c	-	-	-
448	c	-	-	-
449	c	-	-	-

APPENDIX II

Detailed Results for the Rate of Loading Tests on PPG 3235

The individual results obtained for the rate of loading tests on sandblasted, annealed, PPG 3235 specimens are presented in Tables XVII through XXXII. The columns in the tables are titled with Roman numerals and these numerals stand for the following column headings.

Column (Tables XXVII to XXXII inclusive):

I. Identification number of the specimen.

II. Modulus of rupture in pounds per square inch.

III. Fracture origin. S - fracture originated on the surface of the specimen. E - fracture originated on the edge of the specimen.

IV. Location of the fracture origin from one end of the specimen. Distances from four inches to five inches show that fracture occurred between the loading knife edges.

V. Radius of the mirror portion of the fracture surface in inches.

Table XXVII. Modulus of rupture of annealed, sandblasted PPG 3235 specimens loaded at a rate of 10 psi/min

I	II	III	IV	V
232	4,800	S	4-3/4	0.236
235	4,800	S	4-1/2	.203
240	4,900	E	4-1/4	-
244	4,900	S	4-1/2	.266
234	5,100	S	5.0	.187
245	5,100	S	5.0	.217
242	5,400	S	4-1/2	.196
239	5,500	E	5.0	-
236	5,600	S	5.0	.128
241	5,700	S	5.0	.145
237	5,900	S	4-1/2	.128
246	5,900	S	4-3/4	.117
238	6,000	S	5.0	.154
247	6,000	E	4-1/2	-
233	6,100	S	5.0	.130

Table XXVIII. Modulus of rupture of annealed, sandblasted PPG 3235 specimens loaded at a rate of 100 psi/min

I	II	III	IV	V
341	4,300	S	4-1/2	0.313
363	4,300	E	5.0	-
339	4,700	S	5.0	.220
342	5,200	S	4-3/4	.149
336	5,400	S	5.0	.178
337	5,500	S	5.0	.121
346	5,600	S	4-1/2	.134
367	5,600	S	5.0	.147
343	5,700	S	5.0	.128
345	5,700	S	4-3/4	.139
340	5,800	S	4-3/4	.134
361	5,800	S	5.0	.131
348	6,100	S	4-3/4	.122
347	6,300	S	4.0	.129
344	6,600	S	4-3/4	.088

Table XXIX. Modulus of rupture of annealed, sandblasted, PPG 3235 specimens loaded at a rate of 1,000 psi/min

I	II	III	IV	V
188	4,700	S	4-1/2	0.249
264	4,700	E	5.0	-
18	5,200	S	4-3/4	.172
265	5,200	S	4.0	.172
142	5,400	S	4-1/2	.162
145	5,600	S	5.0	.145
133	5,700	S	5.0	.155
266	5,700	S	5.0	.162
191	6,000	S	4-1/2	.120
139	6,100	S	5.0	.113
335	6,100	S	5.0	.117
182	6,200	S	5.0	.124
194	6,200	S	5.0	.135
314	6,400	S	5.0	.107
185	6,500	S	4-1/2	.100

Table XXX. Modulus of rupture of annealed, sandblasted, PPG 3235 specimens loaded at a rate of 10,000 psi/min

I	II	III	IV	V
197	5,300	E	4-1/4	-
183	6,000	S	4-3/4	0.118
143	6,200	S	5.0	.115
192	6,200	S	5.0	.109
195	6,200	S	4-1/2	.133
140	6,500	S	4-1/2	.098
189	6,700	S	4-1/2	.100
267	6,700	S	4-3/4	.090
269	6,900	S	5.0	.061
134	7,000	S	4-3/4	.076
186	7,200	S	5.0	.079
198	7,300	S	4-3/4	.070
137	7,400	S	5.0	.076
268	7,500	S	5.0	.073
146	7,600	S	5.0	.069

Table XXXI. Modulus of rupture of annealed, sandblasted, PPG 3235 specimens loaded at a rate of 100,000 psi/min

I	II	III	IV	V
135	6,000	S	5.0	0.047
138	6,300	S	4-3/4	.059
199	6,600	S	4-1/2	.071
190	6,700	S	4-3/4	.074
187	6,800	S	4-1/2	.071
141	7,000	S	4-3/4	.049
193	7,100	S	4-1/2	.051
184	7,300	S	4-3/4	.078
270	7,400	S	4-3/4	.056
148	7,500	S	5.0	.055
149	7,500	S	5.0	.053
196	7,500	S	4-3/4	.054
144	7,800	S	4-3/4	.049
271	7,900	S	4-1/4	.049
272	8,200	S	5.0	.042

Table XXXII. Modulus of rupture of annealed, sandblasted, PPG 3235 specimens loaded at a rate of 1,000,000 psi/min

I	II	III	IV	V
315	7,400	S	5.0	0.049
321	7,400	S	5.0	-
326	7,600	S	5.0	.047
318	7,700	S	5.0	.047
316	7,800	E	5.0	-
319	7,800	S	5.0	.049
323	8,000	S	5.0	-
325	8,000	S	5.0	.044
317	8,100	S	4-3/4	-
322	8,100	S	4-3/4	.041
320	8,200	S	5.0	-
329	8,200	S	5.0	.040
324	8,400	S	5.0	.040
327	8,500	S	4-1/2	.038
67	8,500	S	5.0	.036

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Unclassified report

In order to establish realistic design information applicable to several special glasses, data have been obtained on the stress-rupture characteristics and the elongation during the stress-rupture tests at room temperature, 700°F, and a temperature 50°C below the

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strain point for Corning Glasses 1723 and 7740, and Pittsburgh Plate Glass 3235. Data are also presented on the effect of the rate of loading on strength.

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